

NASA Conference Publication 3170

The Third Annual NASA Science Internet User Working Group Conference

*Edited by
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Proceedings of a conference sponsored by the
National Aeronautics and Space Administration
and held in Greenbelt, Maryland
March 30–April 3, 1992



National Aeronautics and
Space Administration

Office of Management

Scientific and Technical
Information Program

1993

Acknowledgements

We gratefully thank all the people who contributed to the success of the third annual NSIUWG Conference: the NSI user community, invited speakers and exhibitors, and project staff. In particular, we thank Anthony Villasenor, NSI Program Manager, and Christine Falsetti, NSI Project Manager, for their sponsorship of the conference, and Chairperson Dr. Ron Zwickl and the Subgroup Chairpersons for their excellent leadership. Thanks also to Lenore Jackson for her conference logistics planning and to those at Goddard Space Flight Center who contributed to the production of these proceedings.

Brian Lev
J. Patrick Gary
Editors

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I. Conference Agenda

Third Annual NSIUWG Conference
NSI Networking in the Nineties
March 30 - April 3, 1992

Schedule of Events
(Subject to change)

MONDAY, March 30

- 5:00 - 7:00 Registration and No-Host Reception
- 7:00 - 8:30 Executive Planning Meeting

TUESDAY, March 31

Opening Plenary

- 8:30 - 8:45 Opening Session
 R. Zwickl/NOAA-ERL
- 8:45 - 9:15 NSI Program Update
 A. Villasenor/NASA HQ
- 9:15 - 9:45 NSI Project Update
 C. Falsetti/ARC
- 9:45 - 10:00 BREAK
- 10:00 - 12:00 NSI Panel: Highlights, Status of Previous Findings, Current Issues
 John Martin, SNP/Sterling
 Milo Medin, NSI Engineering/ARC
 J. Patrick Gary, NSI User Services & Applications/GSFC
 Ron Tencati, NSI Security/Hughes STX
- 12:00 - 1:30 LUNCH
- 1:30 - 2:30 Plenary: Subgroup Agenda Review
- 2:30 - 5:30 Subgroup Meetings
- Networking
 - User Services/Applications
 - NSIUWG Organization
- 5:30 - 6:00 Executive Committee Meeting

Exhibit Area open from 10:00 to 5:00

NSI Networking in the Nineties

SCHEDULE OF EVENTS

WEDNESDAY, April 1

8:30 - 8:45 Subgroup Update (in plenary)

Science Networking Keynotes

8:45 - 9:30 UARS Project
 D. DeVito/GSFC

9:30 - 10:15 MARS Observer Project

10:15 - 10:45 BREAK

Network Information / User Services Plenary

10:45 - 11:30 Internet Information Servers
 Joyce Reynolds/ISI

11:30 - 12:15 X.500 White Page Service
 Peter Yee/ARC

12:15 - 1:30 LUNCH (No Host)

1:30 - 2:00 Possible Plenary Session

Subgroup Meetings

2:30 - 5:00 Parallel Subgroup Meetings
 (Break • Networking
 3:00-3:15) • User Services/Applications
 • NSIUWG Organization

7:00 - 10:00 GROUP DINNER (No Host)

Exhibit Area open from 8:00 to 5:00

NSI Networking in the Nineties

SCHEDULE OF EVENTS

Thursday, April 2

8:30 - 8:45 Subgroup Update (in plenary)

Network Communications Technology Plenary

8:45 - 9:30 Internet Forecast
Vinto Cerf/CNRI

9:30 - 10:15 NASA NREN
Milo Medin/ARC

10:15 - 10:45 BREAK

Network Applications Technology Plenary

10:45 - 11:30 Distributed Visualization
Horace Mitchell/GSFC

11:30 - 12:15 TAE
Marti Szczur/GSFC

12:15 - 12:30 Overview of Tutorials and Demos

12:30 - 2:00 LUNCH (No Host)

2:00 - 5:00 **Exhibits** (in parallel with tutorials) **Tutorials** (in parallel with exhibits)

EOS DAAC NCDC & PLDS
NCCS Visualization
NSI NOC & NIC
NSSDC Master Directory
TAE
TGV
X.500 White Pages

On-Line Info Servers (NONA,
Archie, etc.)

NIC staff

Host Security (VMS & UNIX)
Ron Tencati/Hughes STX

Introduction to TCP/IP
John McMahon/TGV, Inc.

Exhibit Area open from 8:00 to 5:00

NSI Networking in the Nineties

SCHEDULE OF EVENTS

Friday, April 3

Closing Plenary

- | | |
|--------------|---|
| 8:30 - 12:00 | Subgroup Summaries <ul style="list-style-type: none">• NSIUWG Organization
<i>Linda Porter/MSFC</i>• User Services/Applications
<i>Neil Cline/JPL</i>• NSIUWG Organization
<i>Ron Zwickl/NOAA-ERL</i> |
| 12:00 | Adjourn |
| 1:30 | Tour of GSFC |

Exhibit Area open from 8:00 to 12:00

THE THIRD ANNUAL NSIUWG CONFERENCE PROGRAM-AT-A-GLANCE

March 30, 1992	March 31, 1992	April 1, 1992	April 2, 1992	April 3, 1992
8:00	Registration	Continental Breakfast		
8:30	Opening Plenary <ul style="list-style-type: none"> • Welcome • NSI Program Updates • NSI Project Updates 	NSI User Project Plenary	Network Communications Technology Plenary	Closing Plenary <ul style="list-style-type: none"> • Subgroup Summaries
12:00	Lunch (no host)	Network Information/ User Services Plenary	Network Applications Technology Plenary	
1:30		Lunch (no host)	Lunch (no host)	
	Parallel Subgroup Meetings & Exhibits	Parallel Subgroup Meetings & Exhibits	Parallel Tutorials & Exhibits	Tour of GSFC Note: Exhibits will remain open until 2:00 p.m.
5:00	Registration & Reception (No Host)	Group Dinner (No Host)		
7:00				

PLENARY SESSIONS OF THE THIRD ANNUAL NSIUWG

	Tuesday, March 31	Wednesday, April 1	Thursday, April 2	Friday, April 3
8:30	<p><u>Opening Plenary</u></p> <ul style="list-style-type: none"> • Welcome <i>Ron Zwickl /NOAA-ERL</i> • NSI Program Updates <i>Tony Villaseñor/ NASA HQ</i> • NSI Project Update and Overview <i>Christine Falsetti/ARC with Milo Medin/ARC John Martin/Sterling Pat Gary/GSFC Ron Tencati/ Hughes STX</i> 	<p><u>NSI User Projects</u></p> <ul style="list-style-type: none"> • UARS <i>Danny Devito/GSFC</i> • Mars Observer 	<p><u>Network Communications Technology</u></p> <ul style="list-style-type: none"> • Internet Forecast <i>Vinton Cerf/CNRI</i> • NASA NREN <i>Milo Medin/ARC</i> 	<p><u>Closing Plenary</u></p> <ul style="list-style-type: none"> • Networking Subgroup <i>Linda Porter/MSFC</i> • User Services/ Applications Subgroup <i>Nell Cline/JPL</i> • NSIUWG Organization Subgroup <i>Ron Zwickl/ NOAA-ERL</i>
12:15	Lunch (No Host)			
1:30	Plenary Session			
2:30	• Subgroup Agenda Review			

PARALLEL SUBGROUP MEETINGS OF THE THIRD ANNUAL NSIUWG

Tuesday, March 3, 1992

	Room A	Room B	Room C
2:30	Networking <i>Chair: Linda Porter/MSFC</i> Tentative Agenda: <ul style="list-style-type: none"> • NSI network update (technical status report) <ul style="list-style-type: none"> - network architecture - protocol summaries - protocol encapsulation update - network management tools used by the NOC • NSI futures <ul style="list-style-type: none"> - Frame relay? - XTP? - OSPF "type of service" routing? - other futures 	Information/User Services <i>Chair: Neil Cline/JPL</i> Tentative Agenda: <ul style="list-style-type: none"> • Welcome <i>Neil Cline/JPL</i> • NSIUWG Direction <i>Pat Gary/GSFC</i> • User Services on the Internet <i>Joyce Reynolds/ISI</i> • Internet Cruise <i>Laura Kelleher/Merit</i> • NSI NIC Organization and Functions <i>Brian Lev/Hughes STX</i> 	NSIUWG Organization <i>Chair: Ron Zwick/NOAA-ERL</i> Tentative Agenda: <ul style="list-style-type: none"> • NSIUWG direction • Other TBD
Break 3:00-3:15			
5:00			

Wednesday, April 1, 1992

	Room A	Room B	Room C
2:30	Networking <i>Chair: Linda Porter/MSFC</i> Tentative Agenda: <ul style="list-style-type: none"> • DECnet and OSI in the NSI <ul style="list-style-type: none"> - What has NASA/NSI done since last meeting? - NSI and the HEP-SPAN DECnet Coordination Group - Implementation of Phase V/OSI in ESnet-DECnet - DECdns naming plans and current implementation - NSI plans for support of CLNP - Question & Answer 	User Services/Applications <i>Chair: Neil Cline/JPL</i> Tentative Agenda: <ul style="list-style-type: none"> • Summary of Tuesday's Discussion <i>Neil Cline/JPL</i> • NSI NIC Help Desk: What It Does; How It Can Help You <i>Bill Yurcik/Hughes STX</i> • Procedures for Providing Network Connectivity <i>John Martin/Sterling Software</i> • Open Discussion <ul style="list-style-type: none"> - NSI NIC Possibilities - Info Tools on the Internet - User Concerns - Feedback on Subgroup 	Applications <i>Chair: Dennis Gallagher/MSFC</i> Tentative Agenda: <ul style="list-style-type: none"> • Crush <i>Ed Seiler/Hughes STX</i> • Scientific Visualization <i>Alan McConnell/Pixel Analysis</i>
Break 3:00-3:15			
5:00			

pm 12:45

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II. Meeting Summaries

NSI User Working Group Conference Overview

On March 30 through April 3 approximately 130 NSI users attended the Third Annual NASA Science Internet (NSI) Users Working Group (NSIUWG) Conference at the Marriott Hotel in Greenbelt, Maryland to learn more about NSI, hear from projects which use NSI, and receive updates about new networking technologies and services. The NSIUWG Conference was sponsored by the NSI User Support Office, which is managed by the GSFC Science Network Office/Code 930.6, and was coordinated by Lenore Jackson of the NSI USO.

The plenary sessions gave listeners the opportunity to hear from a variety of invited speakers. These included NSI project management, scientists and NSI user project managers whose projects and applications effectively use NSI, and notable citizens of the larger Internet community, such as Joyce Reynolds of the University of Southern California Information Sciences Institute, Dr. Vinton Cerf of the Center for National Research Initiatives, and Laura Kelleher of Merit Network, Inc. User subgroups were Networking, chaired by Linda Porter of Marshall Space Flight Center, User Services & Applications, chaired by Dr. Neal Cline of the Jet Propulsion Lab, and NSIUWG Organization, chaired by Dr. Ron Zwickl of the National Oceanographic and Atmospheric Administration. One afternoon offered well-attended tutorials covering the implementation and use of X.500 services, an introduction to TCP/IP, using NSI Network Information Center services, and network-oriented security for both VMS and UNIX operating systems. Several NASA projects also held demonstrations in the Exhibit Area which was interconnected with the NSI at 1.5 Mbps throughout the week.

The NSIUWG Organization Subgroup proposed a number of changes for next year's meeting. For example, because the users wanted the sense of the conference to be understood less as a working group and more as an information exchange, the name next year will change to the NSI Users Forum. This reflects the evolving nature of the conference as a forum for dialog among network users, NSI project personnel, and representatives of various online resources. The Organization Subgroup having completed its job, planning for next year's meeting will begin with only the Networking and User Services subgroups, although others will be added as emerging interests demand. An updated mailing list and improved means of announcing the annual meeting were also recommended.

Some of the elements of the conference which users suggested not be changed were convening annually in March, rotating to sites alternately on the East and West Coasts, retaining the subgroups as an integral part of the meeting, and including presentations by speakers from outside NSI and even outside NASA.

The USO wishes to thank all of the presenters, tutorial instructors, exhibitors, and NSI user attendees who participated in making this NSIUWG Conference a success. The project and all its users thank Dr. Ron Zwickl, Conference Chair, and Linda Porter, Network Subgroup Chair, for their years of service. Both are stepping down this year.

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Plenary Presenters:

Mr. Jeffrey Burgan, Sterling (NSI)
Dr. Vinton Cerf, CNRI
Dr. Theodore Clarke, JPL (Galileo)
Mr. Daniel DeVito, GSFC (UARS)
Ms. Christine Falsetti, ARC (NSI)
Mr. J. Patrick Gary, GSFC (NSI)
Mr. John Martin, Sterling (NSI)
Dr. Horace Mitchell, GSFC (NCCS)
Ms. Joyce Reynolds, ISI
Ms. Marti Szczur, GSFC (TAE)
Mr. Ron Tencati, Hughes STX (NSI)
Mr. Anthony Villasenor, NASA HQ (NSI)
Mr. Peter Yee, ARC (ISODE)
Dr. Ron Zwickl, NOAA/ERL

Subgroup Presenters:

Dr. Randy Barth, Hughes STX (NSI)
Mr. Jeffrey Burgan, Sterling (NSI)
Mr. Todd Butler, RMS/GSFC
Mr. Phil DeMar, FNAL/DOE
Mr. J. Patrick Gary, GSFC (NSI)
Ms. Laura Kelleher, Merit
Mr. Brian Lev, Hughes STX (NSI)
Mr. John Martin, Sterling (NSI)
Dr. Alan McConnell, Pixel Analysis/GSFC
Mr. John McMahon, TGV

NSIUWG Organization Subgroup

Findings:

- 1. Name needs to be changed to NSI Users Forum**
- 2. Continue annual meeting, retain March time frame**
- 3. Meeting site will vary**
 - Retain East/West rotation**
 - Can hold meetings at other sites**
- 4. Subgroups are a necessary part of annual meeting format**
 - Do not want a seminar format**
 - New Subgroups will be formed as needed**
 - Currently two subgroups: Networking, User Services**
- 5. Need updated, more complete mailing list**
 - Announce annual meeting**
- 6. Continue to have presentations from outside of NSI**
- 7. Support National Meetings**
 - Could have lower level of support, such as local dial-up**
- 8. Regional User meetings be held during National Meetings**

NSIUWG Network Subgroup Meeting Summary
March 31- April 1, 1992
Linda Porter/ Subgroup Chairman

Anywhere from 20 to 50 people attended the network subgroup during the two afternoon meeting days. During the two days, various speakers provided much technical information on NSI. Discussions were limited to questions and answers. No formal findings were established, however several requests were made:

Day 1:

- o One or more postscript maps of the network with IP addresses and DECnet addresses should be made available. The "network" in this case is the NSI backbone and directly connected NSI sites over

- a) Proteon or DEC h/w
- b) encapsulated (logical DECnet connectivity only)

The idea is to be able to look at a map and visually trace one's way through the network under either TCP/IP or DECnet. These maps should be made available on the NSINIC and kept up-to-date.

- o Ability to traceroute DEC paths through NSI (similar to ESnet/DECnet capability) The current problems (lack of support) with the NSI provided Proteon routers is understood, however it was noted that in a few months Proteon would be supporting both a nonprivileged access mode and SNMP MIB for DECnet functions. Both tools would be invaluable to the network community, and NSI is requested to keep the community apprised of new developments.

Day 2:

- o There is a mail exploder for DECnet to OSI transition set up for DECnet PV/OSI information. The address is

DECNET-OSI-TRANSITION@NSIPO.NASA.GOV

to be placed on this list, send a request to the address:

DECNET-OSI-TRANSITION-REQUEST@NSIPO.NASA.GOV

- o A request was made to create a Usenet News Group for NSI DECnet to OSI information.
- o Some significant issues were raised with the DECnet VMS/OSI product scheduled for release in the summer timeframe. The VMS product will not fully support full (hierarchical, DECdns) names at first customer ship (FCS). Primary concern is lack of support for RMS. SET HOST and MAIL however, will be supported. Users were asked to make their concerns known to their local Digital offices, if they felt this was a problem in implementing the product as a result. Also, mail can be sent to SEGREST@DC101.DCO.DEC.COM (Robert Segrest, DEC Network Strategic Coordinator for DOE/NASA).

**NSIUWG '92
User Services Subgroup
(A) Follow-up On Last Year's Meeting**

- **Network Requirements Processing**

- *no customer problems reported*
- *further improvements in planning and processing reported*

- **User Help Desk**

- *implemented by USO as outlined last year*
- *network support problem at JSC noted last year appears to have been solved*



**NSIUWG '92
User Services Subgroup
(A) Follow-up On Last Year's Meeting
(Continued)**

- **The NSI NIC**

- *operational as advertised last year*
- *menu-driven system (NONA) demonstrated*
- *user requirements still needed*
- *USENET feed being provided as needed; demand for USENET newsgroup not established*
- *X.500 involvement by NSI demonstrated*

- **Conference Support**

- *plans and schedule for FY 92 shown*
- *formal process for authorization established*



**NSIUWG '92
User Services Subgroup
(B) Findings**

- (1) NSI User Services need to be advertised in media read by NASA scientists.**
- (2) E-mail distribution services need to be made available to NSI customers.**
- (3) There is considerable user demand for on-line availability of network maps, statistics, and performance information.**



**NSIUWG '92
User Services Subgroup
(B) Findings**

- (4) E-mail user comments, concerns, etc... should be solicited prior to the next NSIUWG**
- (5) X.500 pilot support should be continued**
- (6) User Support Office and Planning Office has assembled exceptionally dedicated & talented teams; NASA should make sure they are maintained**



III. Presentation Material

A. Opening Plenary

NSI Program Update

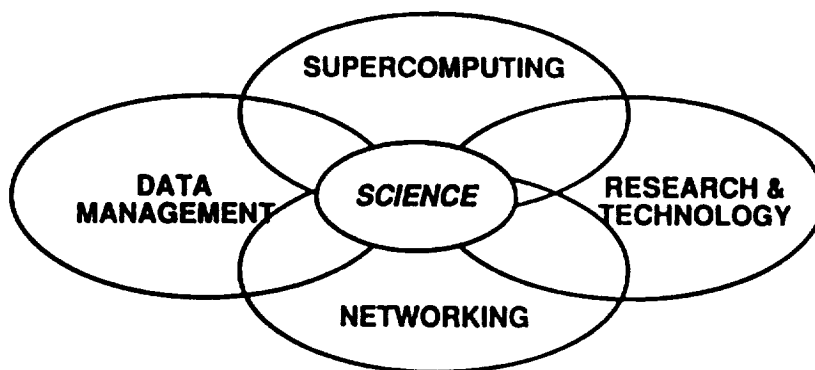


Tony Villaseñor
Program Manager, NASA Science Internet

OFFICE OF SPACE SCIENCE AND APPLICATIONS

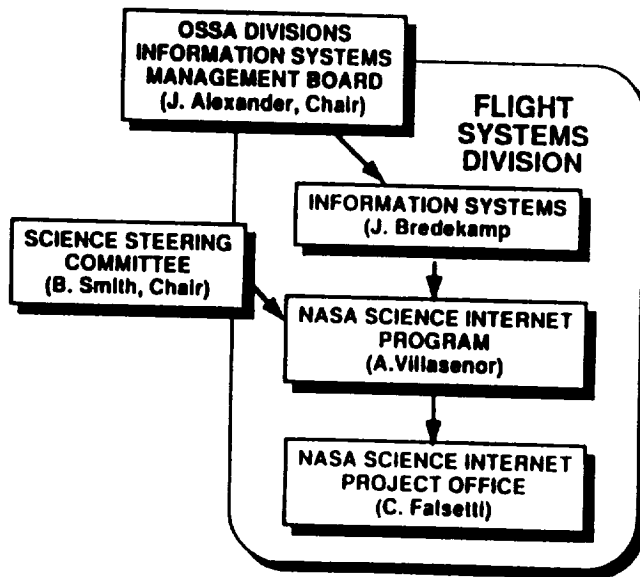


Information Systems: an Integrated Approach



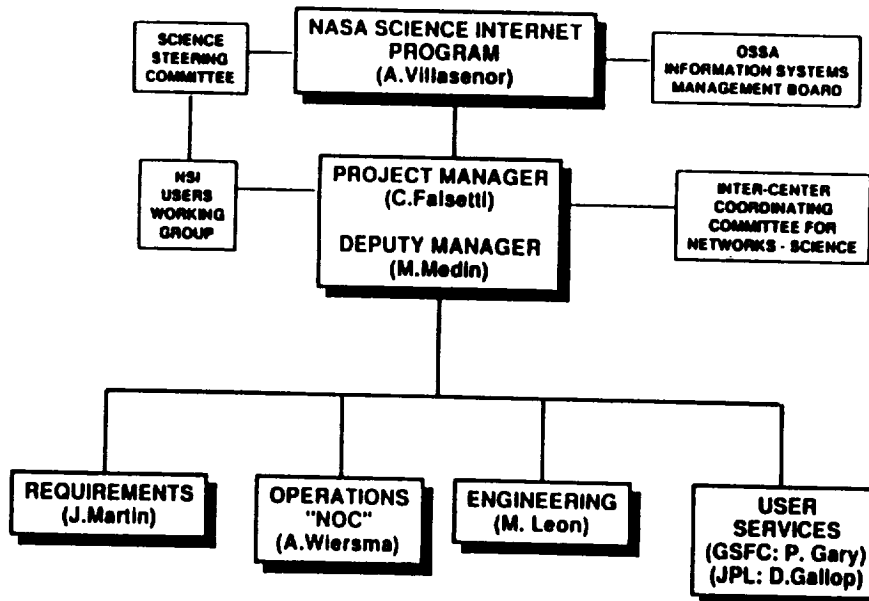
... for Today's Research Environment !

Headquarters Program Organization



NSI - NASA Science Internet

NSI Project



NSI - NASA Science Internet

NSI Acceptable Use Guidelines

SUMMARY:

NSI supports all NASA science flight missions, discipline research programs, and collaborating scientists at NASA Centers and elsewhere.

NSI is not to be used for private gain or profit.

SPECIFIC USES:

- 1) Use of NSI must be in support of official NASA programs; all user requests for NSI connectivity must be validated and supported by cognizant OSSA Discipline Chiefs.
- 2) Use of NSI to support coordination and administrative execution of OSSA research grants is permissible;
- 3) Use of NSI to support NASA research, related training, and associated technical activities at non-profit institutions of research and education is acceptable.
- 4) Use of NSI for commercial or intellectual gain by for-profit organizations is not acceptable, unless those organizations are using NSI to satisfy specific NASA contract or grant requirements.
- 5) Use of NSI for research or education at for-profit institutions will be reviewed on a case-by-case basis to ensure consistency with OSSA programs; lack of program approval will result in disconnection.
- 6) Use of NSI to gain unauthorized use of resources attached to NSI will result in disconnection and legal prosecution. NSI will make every attempt to implement precautions to safeguard against unauthorized use of NASA computers, databases, and other attached federal resources.

NSI - NASA Science Internet

NSI Grades of Service

BASIC SERVICE

- Required connectivity to data archives, computational facilities, and collaborators worldwide; up to 56kbps
- Reliable communications monitored continuously (24 x 7), including automatic fault detection procedures initiated within minutes of occurrence.
- Full interoperability with science and research communities via NSFnet, ESnet, and other INTERNET networks in the U.S. and abroad; also interoperable with the evolving NREN.
- Broad spectrum of network applications including electronic mail, file transfer, remote log-on, etc.
- User consultation and technical assistance through NSI "Help Desk" and network documentation.

PRIORITY SERVICE

All the above, plus:

- Dedicated private circuits between specific facilities.
- Very high performance service, T1 or greater, to end users.
- Non-standard installations and applications requiring specially engineered solutions and equipment.
- Large influx of requirements for new circuits needed for operational use within two years of current budget cycle.

NSI - NASA Science Internet

PRIORITY SCHEMA (2/20/92)

INFRASTRUCTURE

- 0* Provide a high quality, reliable, 24 hour per day by 7 days a week, open access network connecting all current OSSA science missions, investigators, their data archives and computational resources. Includes basic network services such as e-mail, file transfer, remote logon, Internet & Inter-Center access, security management, and basic science conference support as approved by the ISMB, etc.

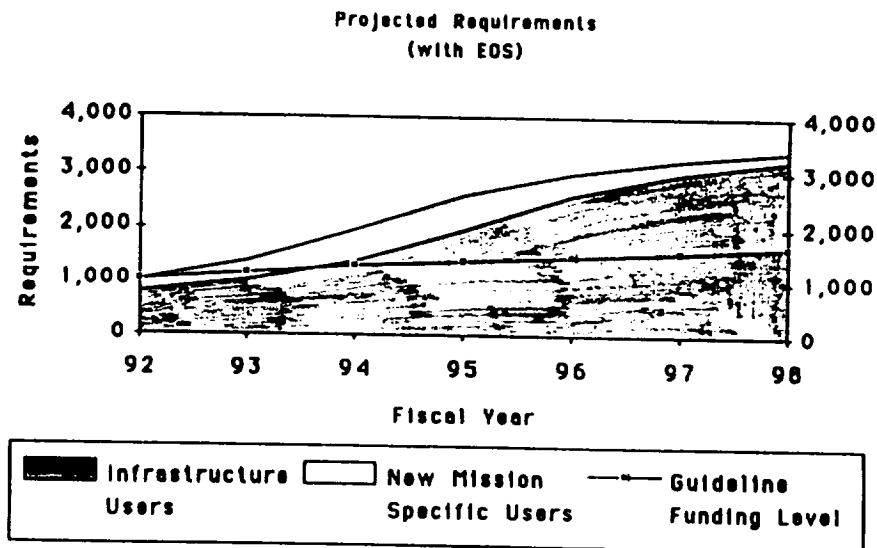
MISSION SPECIFIC RESOURCES

- 1 Current active missions and campaigns where data is now being acquired and used for science analysis; e.g., UARS, GALILEO, KAO, etc.
- 2 Near-term missions, campaigns, & research projects which will require NSI services in 6 months (circuit order time). e.g., EOS, ISTP, Balloons, etc.
- 3 OSSA Infrastructure or science projects with management visibility: key science conferences, JOVE, Eastern Bloc access, coordination with PSCN, ICCN, NSF, OAET/NREN, etc.
- 4 Long-term missions & projects: Antarctica, AXAF, etc.
- 5 Generic network services for space science community not directly traceable to specific project or discipline requirements: DECnet Phase V planning, performance measurement, requirements management, security, industry (IETF) collaboration, etc.
- 6 NSI technology enhancements, such as network applications, software/hardware upgrades, NSIUWG technical forum, OSI transition planning, satellite-ground interoperability, Appletalk encapsulation, packet radio applications, etc. In general, items that improve NSI robustness.
- 7 Science conferences with supplemental funding, support for external activities such as NIST testbed, etc. Items that do not effect "NSI success" as perceived by OSSA Divisions.

*0 = highest priority

NSI - NASA Science Internet

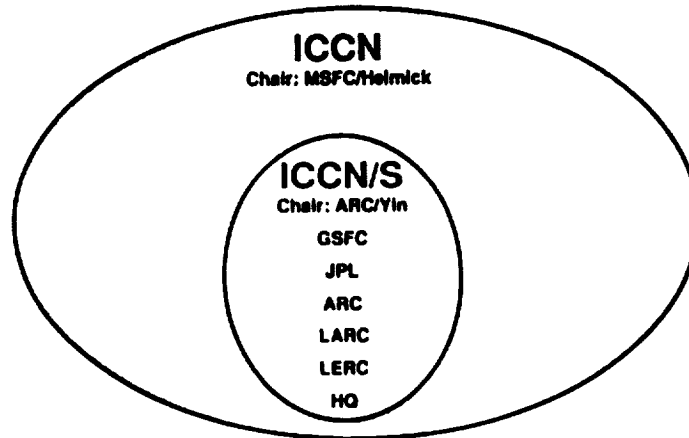
Projected Requirements Growth



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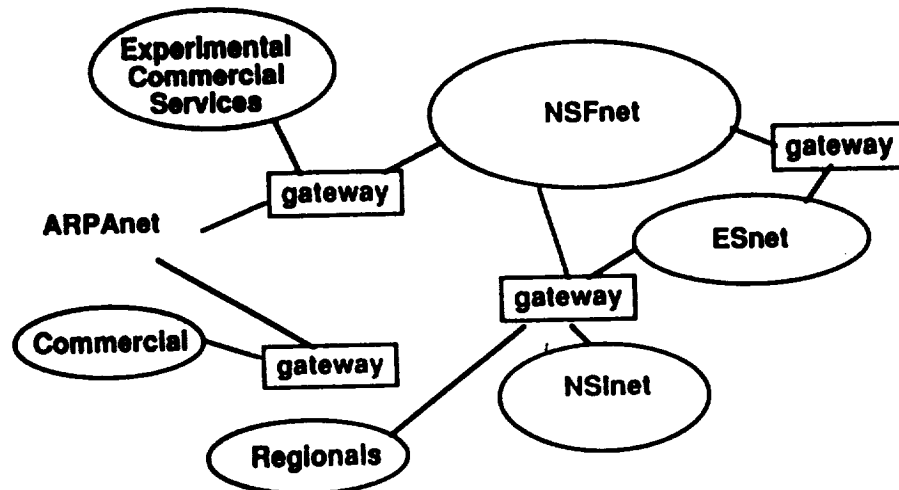
NASA CENTERS

INTER-CENTER COORDINATING COMMITTEE FOR NETWORKING
and
ICCN for Science



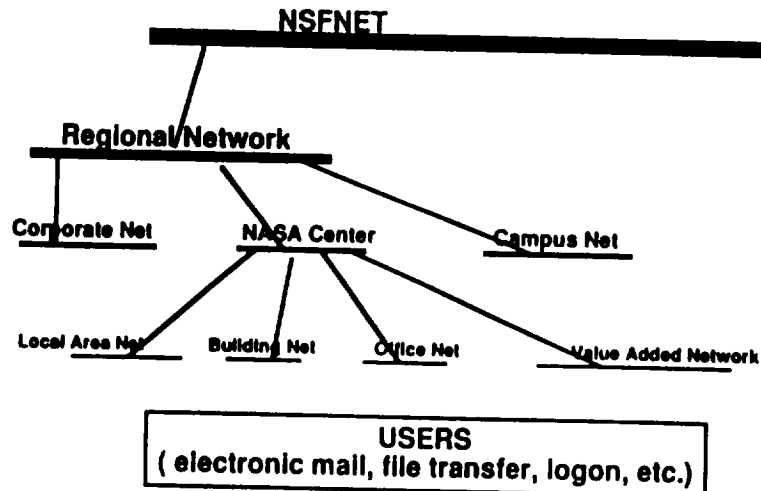
NSI - NASA Science Internet

The "Internet"



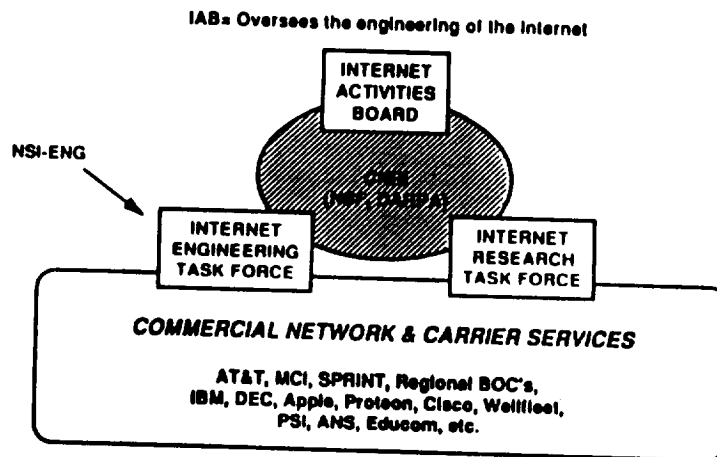
NSI - NASA Science Internet

National Network Hierarchy

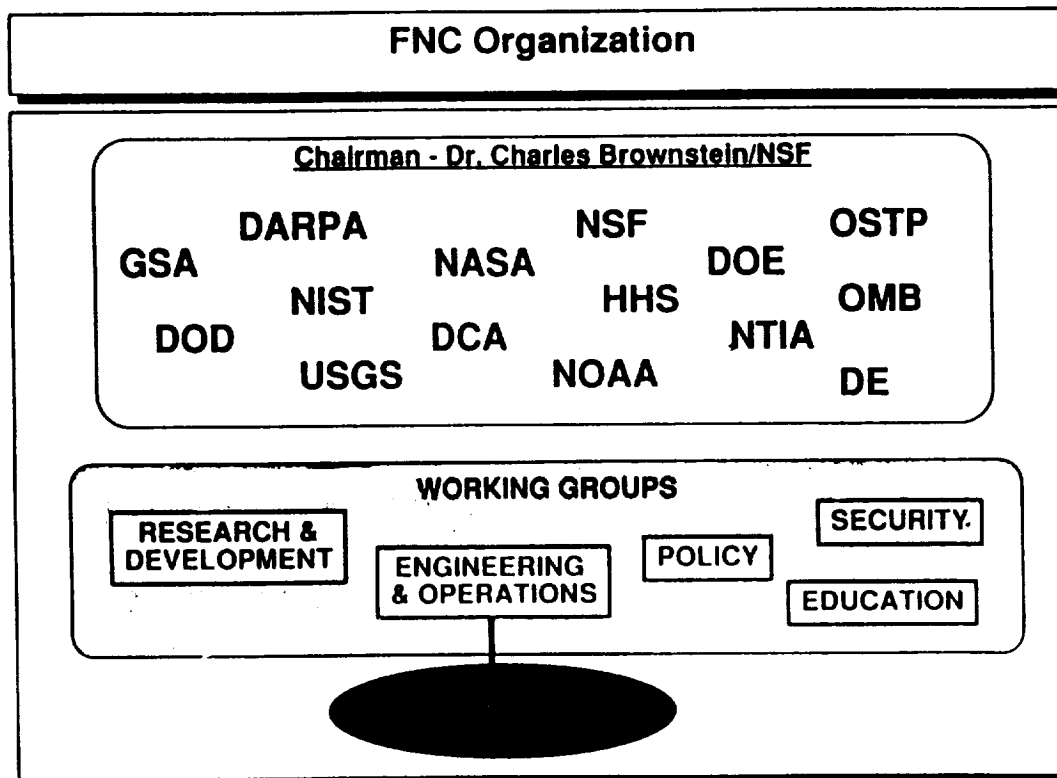


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INTERNET COMMUNITY :



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FNC WORKING GROUP CHAIRS

<u>Chairperson</u>	<u>Working Group</u>	<u>Affiliation</u>
Steve Wolff	All Groups	FNC Exec Director
John Cavallini	Policy	FNC/DOE
Tony Villasenor	Eng & Ops	FNC/NASA
Paul Mockapetris	R & D	FNC/DARPA
TBD	Security	FNC/NIST
TBD	Education	FNC/DE

NSI - NASA Science Internet

Engineering & Operations Working Group

MEMBERS

INITIAL MEMBERSHIP OF THE EOWG WOULD CONSIST OF BUT NOT BE LIMITED TO THE FOLLOWING, BECAUSE OF THEIR STRONG VESTED INTEREST IN THE ENGINEERING AND OPERATION OF THE INTERNET:

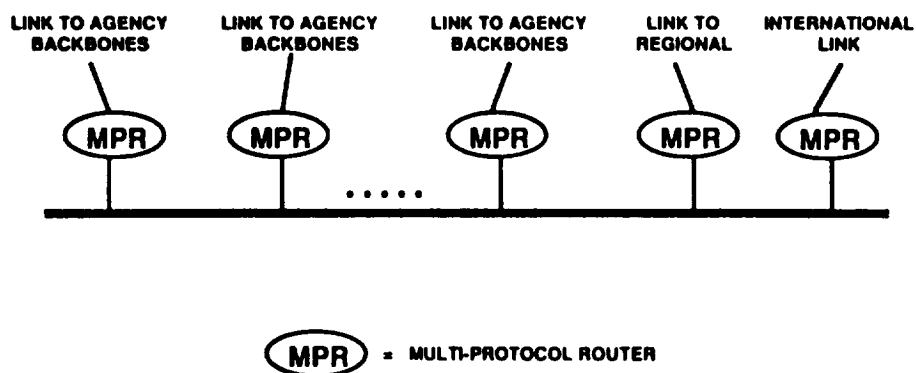
Tony Villasenor, NASA - Chairman
Steve Wolff, NSF - Vice Chairman
John Cavallini, DOE - Vice Chairman
Bill Bostwick, U.S./CCIRN
Paul Mockapetis, DARPA
TBD, FARNET
TBD, IAB

Note: Operations managers of key federal networks may be included as members. The EOWG will provide delegates to CCIRN meetings.

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Federal Internetwork Exchange ("FIX")

An Example



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CCIRN

COORDINATING COMMITTEE FOR INTERCONTINENTAL RESEARCH NETWORKING

The purpose of the CCIRN is to agree and progress a set of activities to achieve inter-operable networking services between participating entities (currently North America and Europe) to support open research and scholarly pursuit. Policy, management, and technical issues will be examined, based on agreed requirements. More precisely, the committee aims to:

- a. stimulate cooperative intercontinental research by promoting enhanced interoperable networking services, specifically
 - promoting the evolution of an open, international research network in line with official policies on the use of international standards,
 - coordinating and facilitating effective use of the international networks to enhance the quality of research and scholarship.
- b. optimize use of resources and to coordinate international connections of the networks represented on the CCIRN
- c. coordinate development of international network management techniques
- d. exchange results of networking research and development

NSI - NASA Science Internet

International Technical Coordination

CURRENT ACTIVITIES

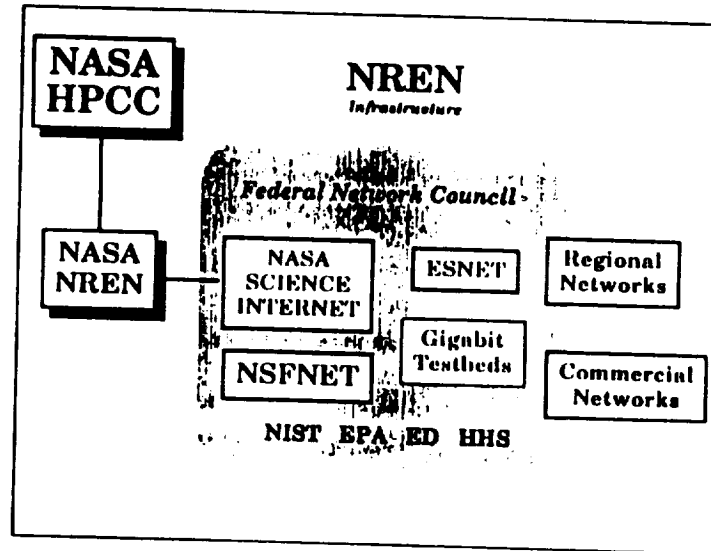
- inter-continental link coordination and planning
- global domain name system
- uniform network statistics and monitoring
- global registration
- global routing
- national character sets
- coordination among network control centers
- CLNS introduction
- mapping
- electronic mail interoperability & reliability

FUTURE TOPICS

- international X.400 with X.500 directory services
- international voice/video teleconferencing
- resource accessibility; authorization; control
- resource control: costing and accounting
- relevant national policy concerns

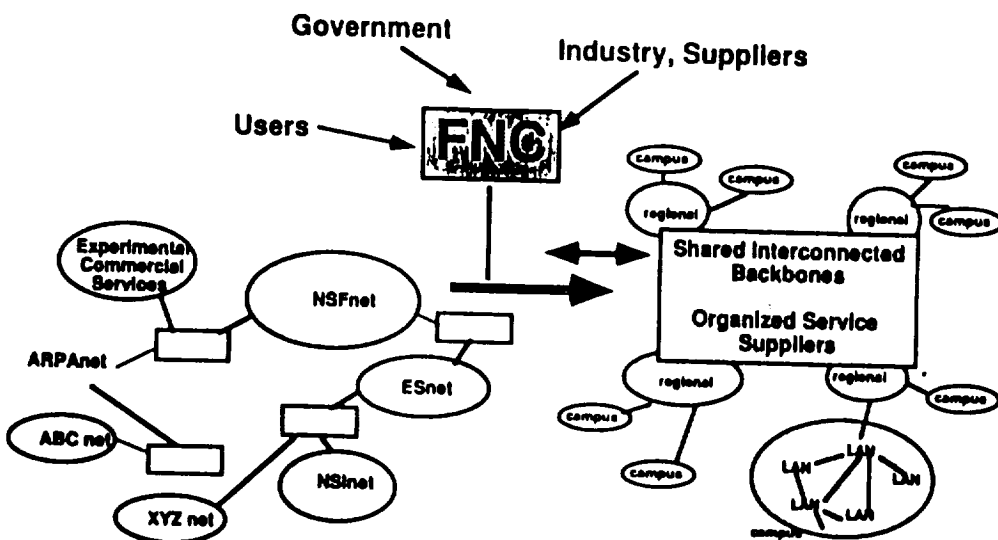
NSI - NASA Science Internet

OAST-OSSA NREN Relationships



NSI - NASA Science Internet

EVOLUTION INTO THE NREN



NSI - NASA Science Internet

NSI Project Update



***The NASA Science Internet -
NASA's Worldwide Science Communications Network***

NSIUWG 1992

**Christine M. Falsetti
NASA Science Internet Office
Information and Communications Systems Division
AMES RESEARCH CENTER**



Outline

- I. Background***
- II. Current Services and Architecture***
- III. Future Directions***

The NASA Science Internet

Recognizing that science communications networking is an integral element of successful science, the NASA Science Internet Office was established in 1988 to provide communications to NASA's entire science community. NSI absorbed U.S. SPAN and NSN when the program was formally established.

The NSI provides computer networking services, management and operations support, and technical assistance to authorized users throughout NASA centers and research institutions worldwide.

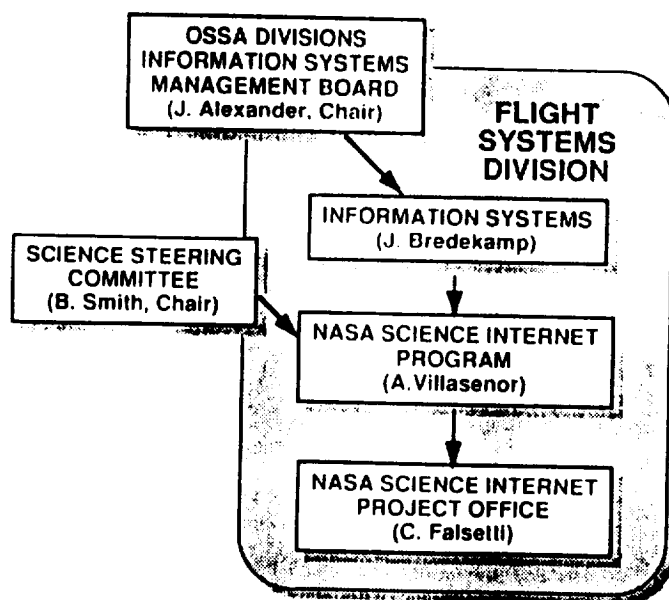
NSI's goal is to provide a high-speed communications network that connects all space scientists, providing ready access to data and information stored anywhere in the world.



NASA Science Internet Project Office

CMFalsetti 3

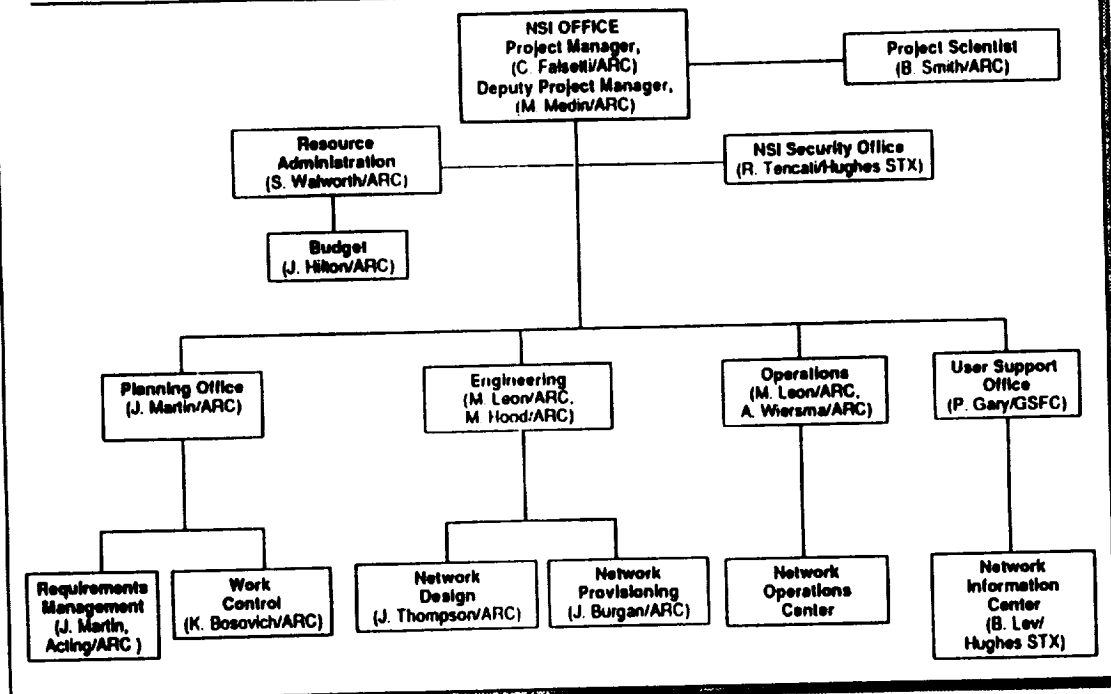
Program Organization Chart



NASA Science Internet Project Office

CMFalsetti 4

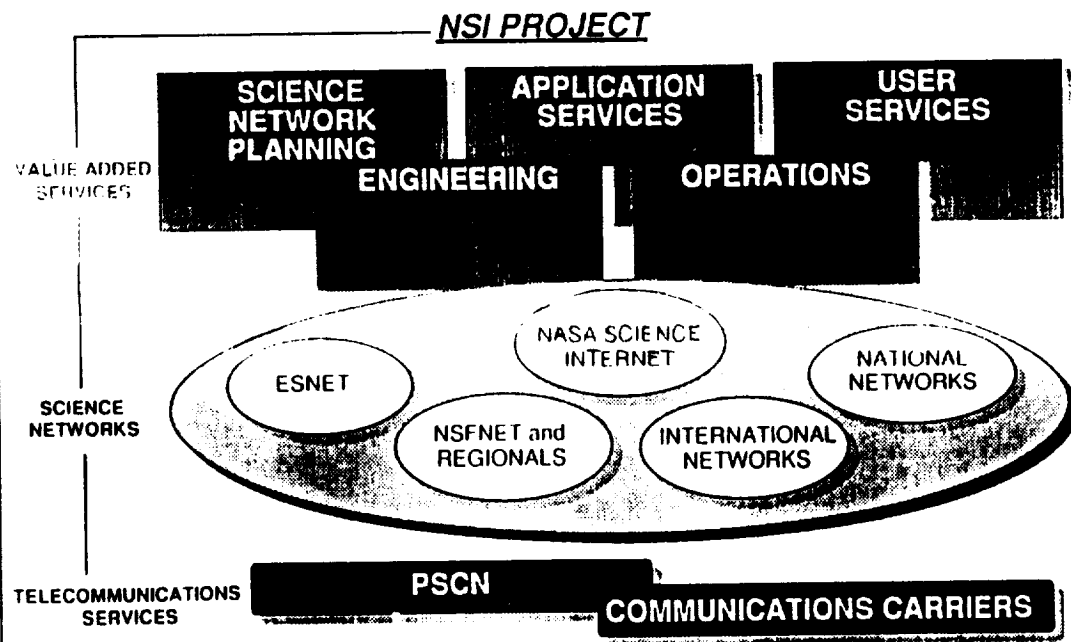
NSI Project Organization



NASA Science Internet Project Office

CMFalsetti 5

Service Organization



NASA Science Internet Project Office

CMFalsetti 6

Value-Added Services

Science Network Planning
Systems Planning - MOU development
Requirements management and validation
Tracking and Status Reporting
Conference Management

Engineering
Network architecture configuration,
Custom design & documentation
Network service acquisition and testing
Development & Implementation of
Security measures and tools

Network Operations
7-day, 24-hr. Network Operations Center
Network Monitoring and Traffic Analysis
Problem Management: reporting, repair
Equipment Installations,
Upgrades,
and Maintenance

**User Support Services &
Applications Development**
Coordinate Integration of OSSA
Information Systems
Network Information Center
White/Yellow Pages directory services
User Help Desk
NSI User Working Group

NASA Science Internet Project Office

CMFAlsetti 7

Community Served by NSI

NSI PROVIDES SERVICE TO:

OSSA DISCIPLINES AND FLIGHT PROJECTS:

SOffice of Space Science and Applications	
SB	Life Sciences
SE	Earth Sciences
SL	Solar System Exploration
SM	Flight Systems
SN	Microgravity
SP	Administration and Resource Management
SS	Space Physics
SZ	Astrophysics

External

Intercenter Coordinating Committee
for Science Networking:

JPL	GSFC	ARC
LeRC	LaRC	HQ

Basic Infrastructure for
Network Operations

UNEP/GRID
United Nations Environmental Program/
Global Research Information Database

NASA Science Internet Project Office

CMFAlsetti 8

NSI Support of NASA Science

Life Sciences Division
 Space Life Sciences 1-4
 Cosmos
 Spacelab J

Solar System Exploration

Voyager
 Magellan
 Galileo
 Ulysses
 Mars Observer
 CRAF/Cassini
 Pioneer

Earth Science and Applications

Crustal Dynamics
 Upper Atmospheric Research (UARS)
 Ocean Topography (TOPEX)
 Earth Observing System (EOS)
 WETNET

Microgravity Science

Materials Science Lab
 International Microgravity

Astrophysics

Explorer Program
 Scout Program
 Supernova
 Cosmic Background Explorer
 Gamma Ray Observatory
 Hubble Space Telescope

Space Physics

Dynamics Explorer
 International Cometary Explorer
 Solar Maximum Mission
 International Solar Terrestrial Physics
 Rockets and Balloons

NASA Science Internet Project Office

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Planning Process

"Working Together"



**Contact Science
 Discipline**

*Understand and Participate in
 Information Systems Planning Process
 and Requirements Development*

*Identify and Conceptualize
 Communications Architecture*

Draft and Sign Discipline MOU



**Transfer to Production
 Manage Requirements
 throughout operation**



NASA Science Internet Project Office

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Outline

- I. Background**
- II. Current Services and Architecture**
- III. Future Directions**

NASA Science Internet Project Office

CMFalsetti 11

NSI OSSA Requirements

Code S	Office of Space Science & Applications	148
Code SB	Life Sciences Division	21
Code SE	Earth Science & Applications Division	886
Code SL	Solar System Exploration Division	260
Code SM	Flight Systems Division	8
Code SN	Microgravity Science & Applications Division	4
Code SP	Administration and Resource Mgmt Division	0
Code SS	Space Physics Division	158
Code SZ	Astrophysics Division	82

TOTAL number of OSSA requirements: 1567

NASA Science Internet Project Office

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NSI Acceptable Use Guidelines

SUMMARY:

NSI supports all NASA science flight missions, discipline research programs, and collaborating scientists at affiliated research institutions.

NSI is not to be used for gain or profit by non-NASA organizations engaged in non-NASA business.

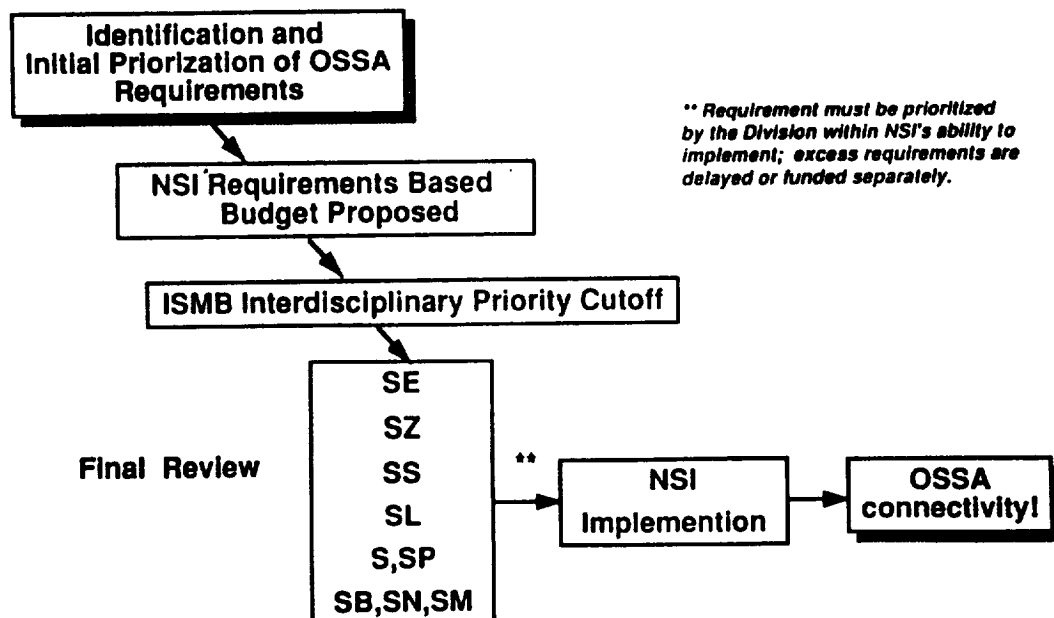
SPECIFIC:

- 1) Use of NSI must be in support of official NASA programs; all user requests for NSI connectivity must be validated (and possibly funded) by cognizant OSSA Discipline Chiefs.
- 2) Use of NSI to support coordination and administrative execution of OSSA research grants is permissible;
- 3) Use of NSI to support NASA research, related training, and associated technical activities at non-profit institutions of research and education is acceptable.
- 4) Use of NSI for commercial or intellectual gain by for-profit organizations is not acceptable, unless those organizations are using NSI to satisfy specific NASA contract or grant requirements.
- 5) Use of NSI for research or education at for-profit institutions will be reviewed on a case-by-case basis to ensure consistency with OSSA programs; lack of program approval will result in disconnection.
- 6) Use of NSI to gain unauthorized use of resources attached to NSI will result in disconnection and legal prosecution. NSI will make every attempt to implement precautions to safeguard against unauthorized use of NASA computers, databases, and other attached federal resources.

NASA Science Internet Project Office

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Process to Prioritize OSSA requirements...



NASA Science Internet Project Office

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Priority Schema as of 2/20/92

INFRASTRUCTURE

- 0* Provide a high quality, reliable, 24 hour per day by 7 days a week, open access network connecting all current OSSA science missions, investigators, their data archives and computational resources. Includes basic network services such as e-mail, file transfer, remote logon, Internet & Inter-Center access, security management, and basic science conference support as approved by the ISMB, etc.

MISSION SPECIFIC RESOURCES

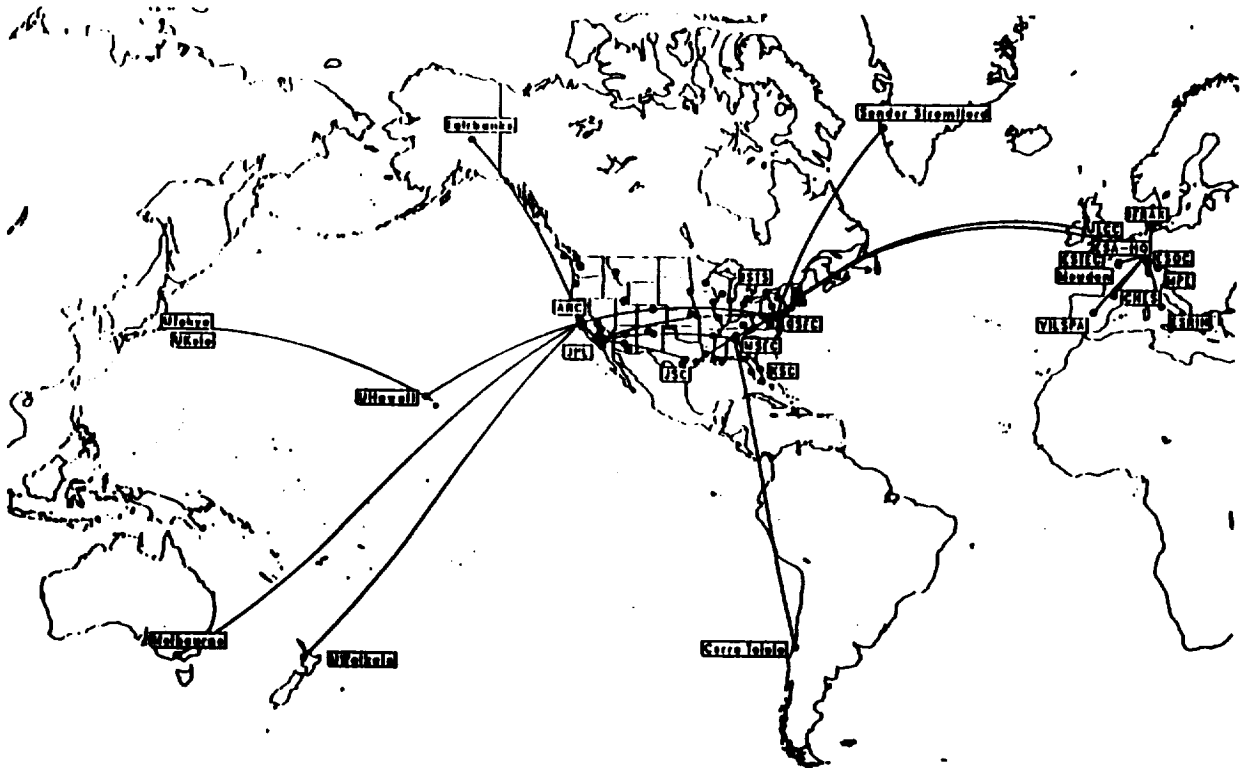
- 1 Current active missions and campaigns where data is now being acquired and used for science analysis; e.g., UARS, GALILEO, KAO, etc.
- 2 Near-term missions, campaigns, & research projects which will require NSI services in 6 months (circuit order time). e.g., EOS, ISTP, Balloons, etc.
- 3 OSSA Infrastructure or science projects with management visibility: key science conferences, JOVE, Eastern Bloc access, coordination with PSCN, ICCN, NSF, OAET/NREN, etc.
- 4 Long-term missions & projects: Antarctica, AXAF, etc.
- 5 Generic network services for space science community not directly traceable to specific project or discipline requirements: DECnet Phase V planning, performance measurement, requirements management, security, industry (IETF) collaboration, etc.
- 6 NSI technology enhancements, such as network applications, software/hardware upgrades, NSIUWG technical forum, OSI transition planning, satellite-ground interoperation, Appletalk encapsulation, packet radio applications, etc. In general, items that improve NSI robustness.
- 7 Science conferences with supplemental funding, support for external activities such as NIST testbed, etc. Items that do not effect "↑ SI success" as perceived by OSSA Divisions.

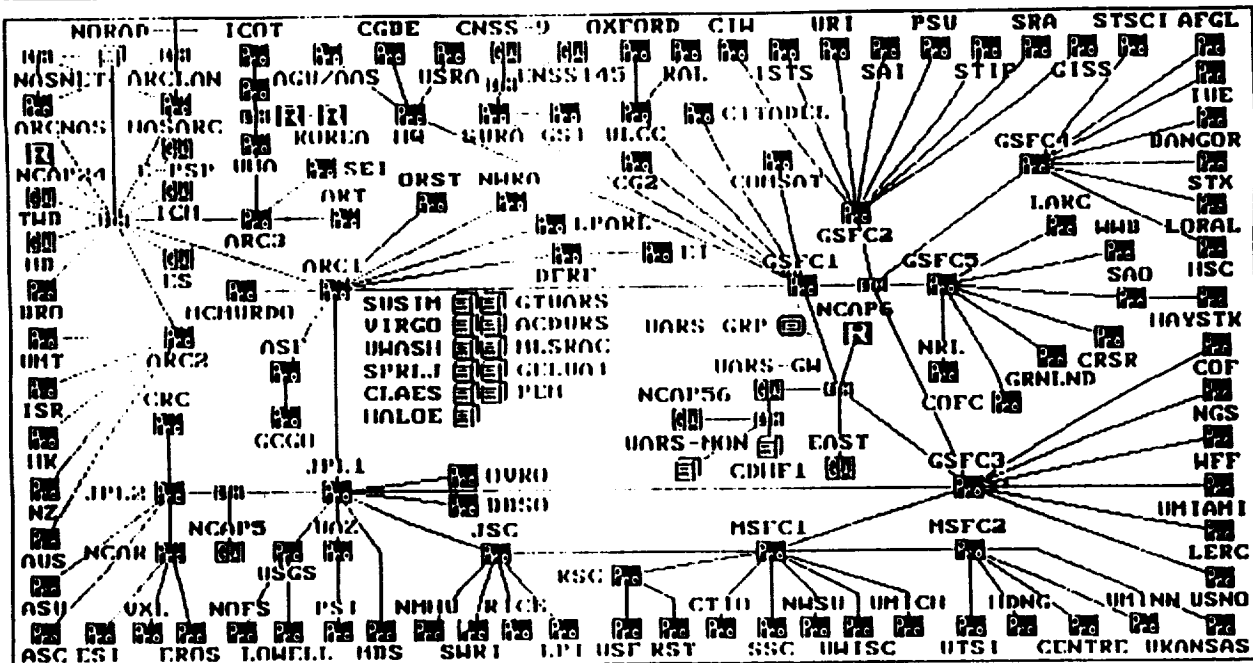
*0 = highest priority

NASA Science Internet Project Office

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NASA Science Internet





NSI Traffic Growth

	Bytes/day	Packets/day
March 1991	8 Billion	38 Million
March 1992	20 Billion	110 Million

Note:
Average traffic increased 250%.
Average packet size - 200 bytes

NSI - NASA Science Internet

NSI Today

CONNECTIVITY

~10000 hosts & 25000 researchers worldwide - In FY91, NSI implemented an additional 205 requirements to 60 sites; by end FY92, NSI will satisfy 233 requirements to 58 new sites, thereby reaching approximately 25000 hosts and 60000 researchers worldwide.

Access to most U.S. universities & labs

Access to ~3 million users via the Internet

Most major countries in Europe & Asia

SERVICE

High reliability - NSI-NOC provides continuous 24x7 monitoring for >125 nodes; 90% of faults fixed within 30 minutes, 97% of all 'trouble tickets' detected by NSI-NOC before user knew problem existed!

High performance - NSI continually upgrades bandwidths while optimizing and tuning the network performance.

Strong user support & interaction at all levels - Established strong ties with OSSA Divisions to review, justify, prioritize & track requirements. Ongoing user assistance provided by User Support Office through the NIC (24 hour online service, prime shift phone coverage, end-user documentation)

Proven technical expertise & leadership in networking - NSI provides proactive leadership in several Federal and International Networking coordination efforts such as the FNC, FEPG < IETF, CCIRN, etc.

INTEROPERABILITY

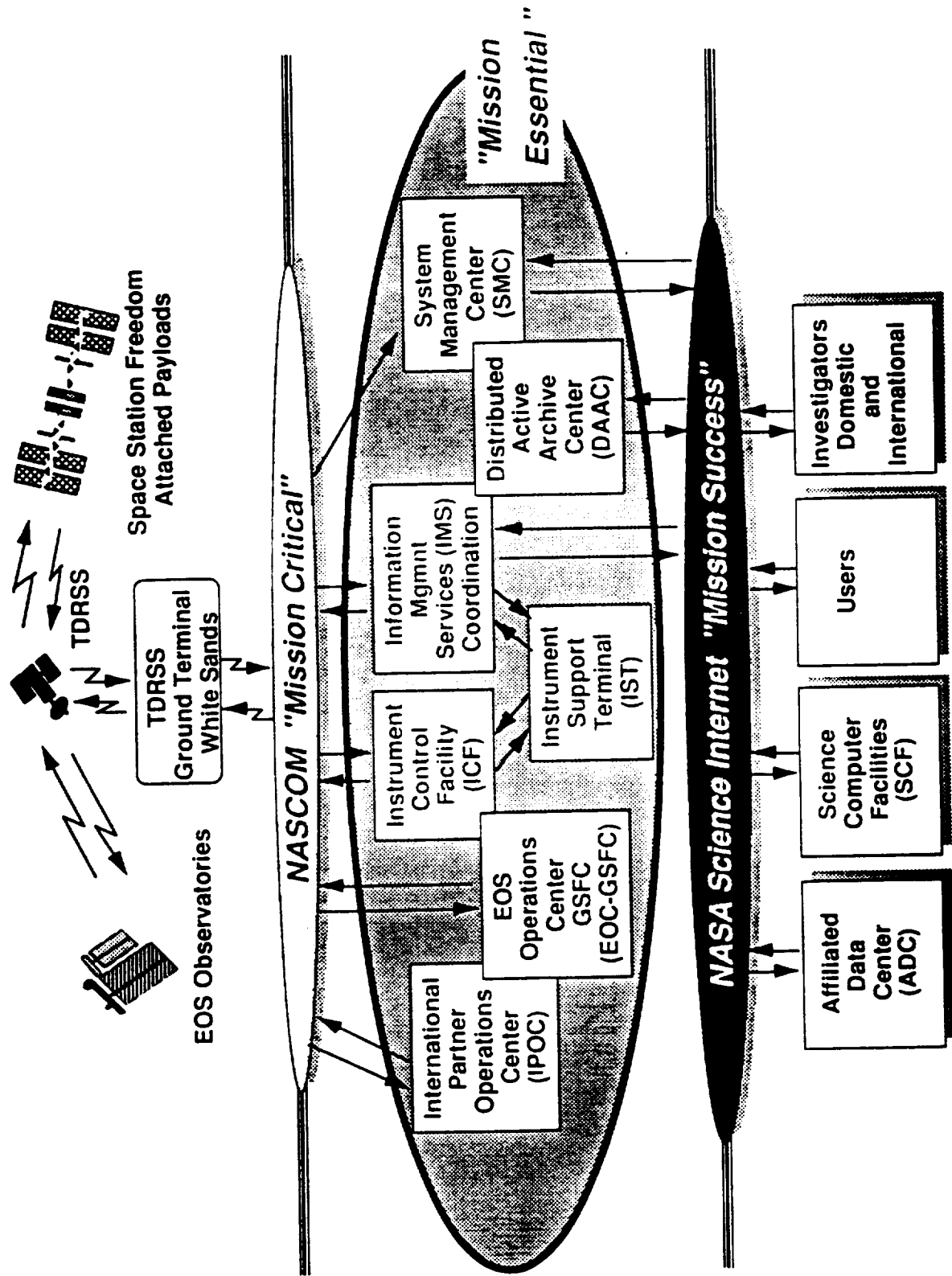
Between TCP/IP and DECnet science networks

With universities on the Internet, NREN, Regional & Campus networks

With commercial networks: Sprint, Omnet, PSI, ANS, etc.

With key universities and research facilities in Europe, Asia, S.America, Australia, New Zealand

NSI'S RELATIONSHIP TO NASCOM

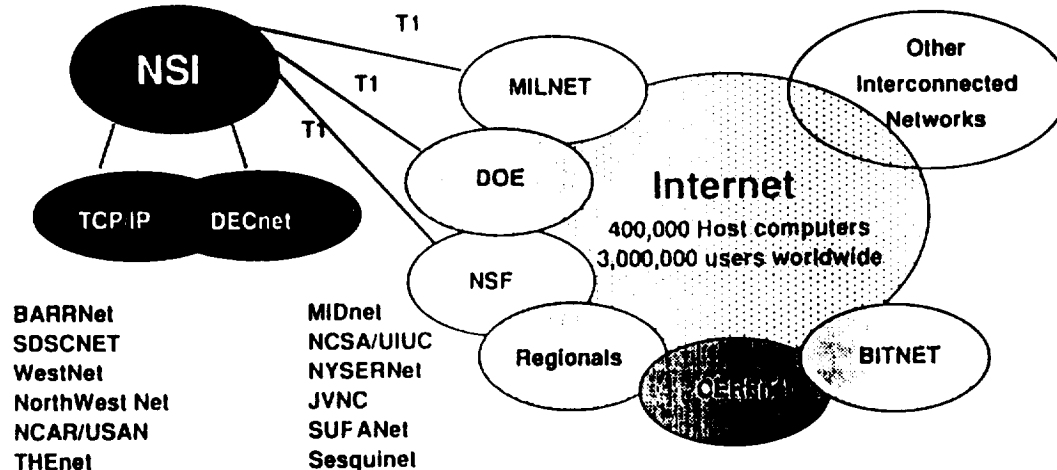


NSI and the INTERNET

NSI is a major participant in the National Internet community.

NSI connectivity is extended to other sites via NSF, DOE, DARPA, and other linkages.

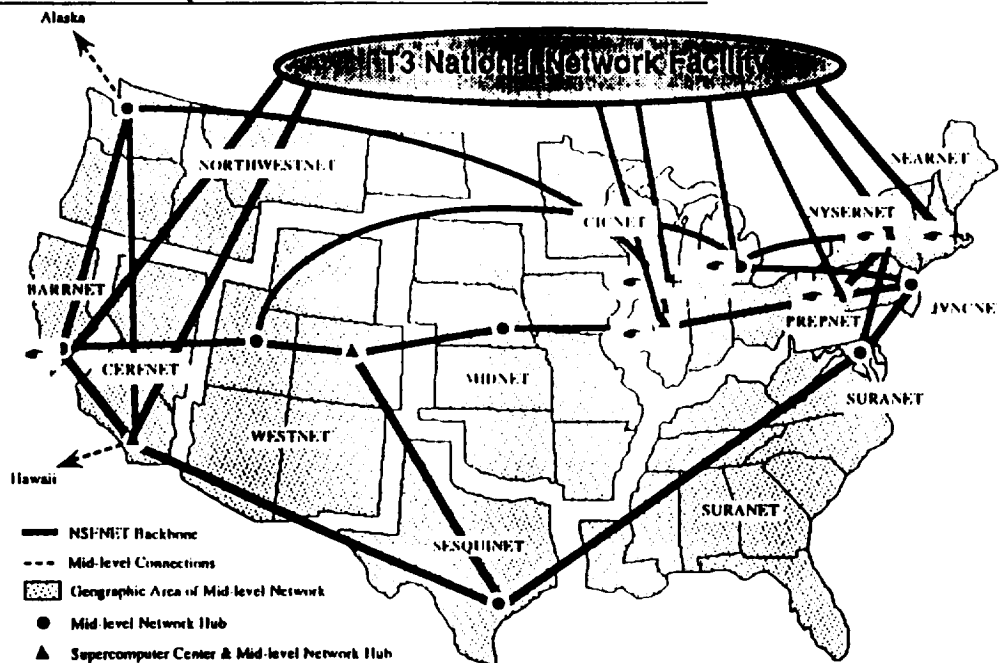
International connectivity is augmented by DOE, ESA, PACCOM, and DARPA networks.



NASA Science Internet Project Office

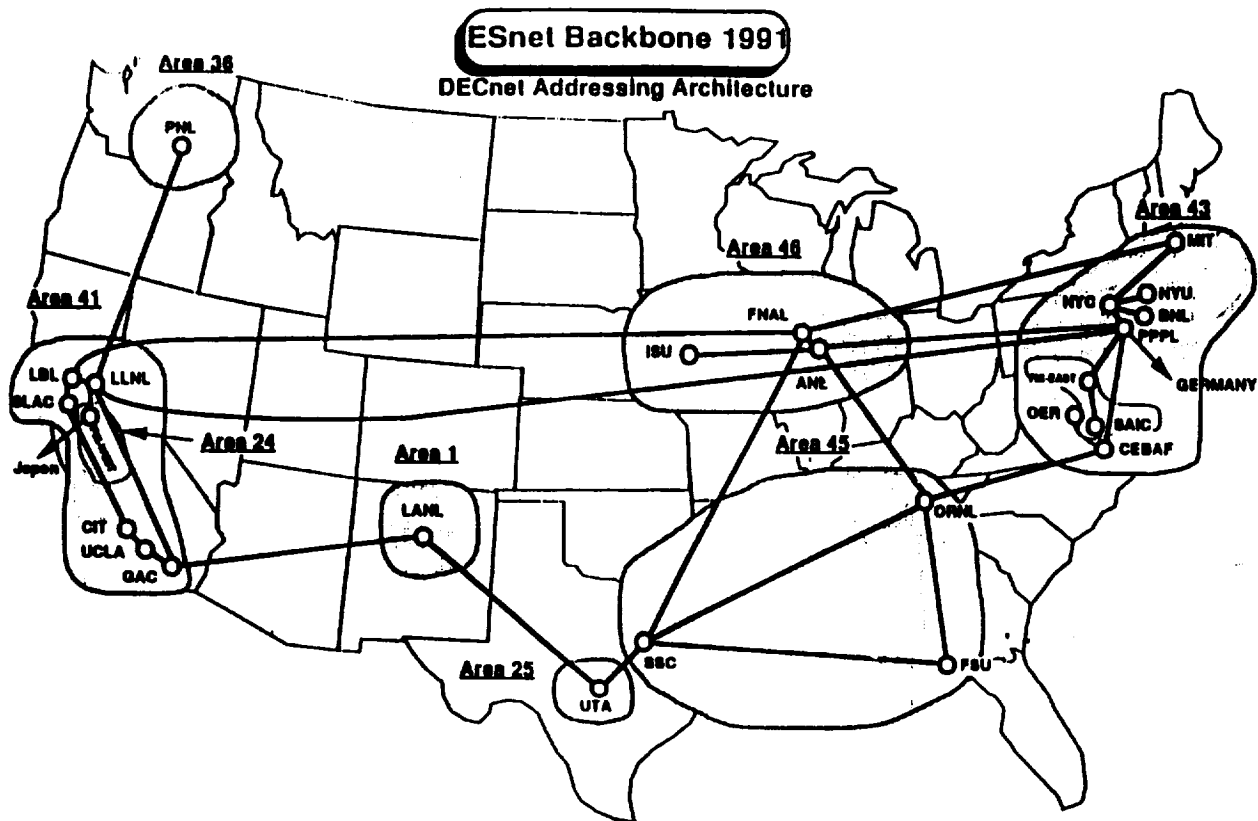
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NSFnet Map



NASA Science Internet Project Office

CMFalsetti 20



NSI Challenges

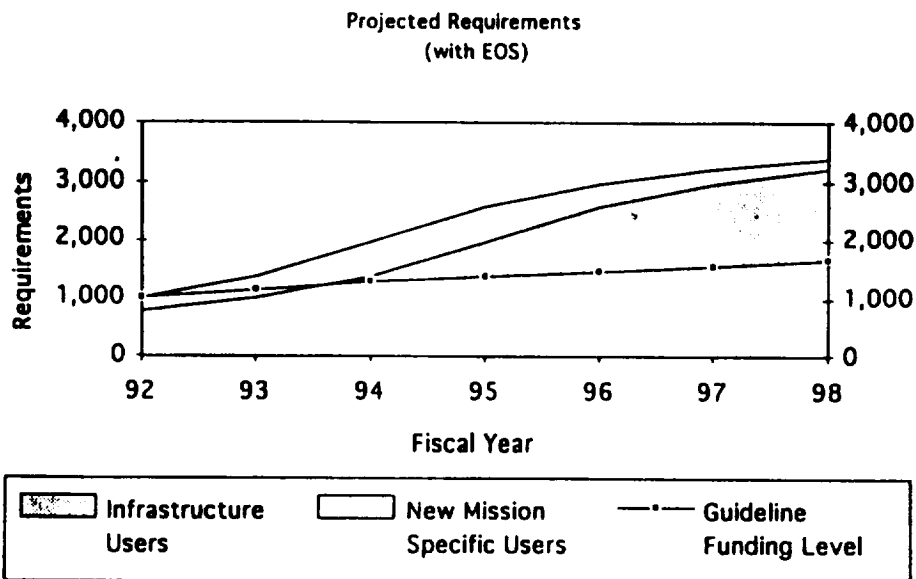
Environment:

- NSI is strictly requirements driven. Networking services are in high demand as shown by explosion in OSSA requirements. As OSSA requirements grow, then more resources are needed to satisfy demand, despite NSI's leverage & economies of scale, since every site demands unique attention.
- Current network architecture is a complex, interdependent service web with federal and international network service providers.
- Emerging NREN and new ISDN broadband technologies will provide challenges of incorporation in our networking infrastructure.

Current Issues:

- Requirements are growing much faster than current NSI resources can meet; growth rate is ~400 requirements per year vs. implementation capacity of 200 per year; many FY92 requirements will be delayed to FY93 & 94. Tight FY92 budget put NSI behind the curve and it cannot catch up.
- Dependency on NSFnet as backbone supplier in FY94 uncertain. NSF plans to dismantle NSFnet on April 1994 & switch to NREN, without testbed demo. for routing & backbone mgmt. NSI needs to use PSCN backbone links to Regionals/Commercials.
- EOSnet is the most critical 'success' component of EOSDIS, as determined by NRC Review.

NETWORK REQUIREMENTS



NASA Science Internet Project Office

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NSI Management Options

1. Advocacy of OSSA Information Systems Budget to include NSI overguideline requests. In FY93, this would accommodate new/delayed requirements from EOSDIS, UARS, Crustal Dynamics, Mars Observer, ISTP, SLS & IML, FLINN, rockets/balloons, etc. In FY94, NSI would establish a new baseline to catch up with requirements growth, use new PSCN circuits during NSFNET transition & stabilization to NREN, continue to build EOSDIS Network, accommodate emerging local site ethernet with high bandwidth workstations, and address proliferating OSSA requirements for NREN usage.

Advantage: Program retains its interdisciplinary perspective and leverage. Economies of scale and networking efficiencies are maximized across disciplines and priorities are established at an interdisciplinary level with support from the ISMB.

Result: Economies of scale and efficiency are maintained as interdisciplinary perspective is ensured.

2. NSI directly negotiates supplemental funds from each Division. Initiate a division tax scheme in FY93/94 time frame.

Disadvantage: Program serves individual discipline interests as opposed to a unified OSSA program. Many captains leading ship, loss of interdisciplinary efficiencies and control.

Result: Economies of scale and efficiencies compromised. Interdisciplinary perspective is not ensured. Program may become fragmented as discipline interests are not moderated.

NSI Recommends Management Option Number 1

NASA Science Internet Project Office

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Outline

- I. Background**
- II. Current Services and Architecture**
- III. Future Directions***

Vision

- **A single integrated network, under OSSA control, tailored to NASA science needs**
- **Transparent ubiquitous access to science data archives, computational resources, and colleagues worldwide**
- **Total spectrum of network services: guaranteed bandwidth, priority routing, selective routing, protocol transparency, multi-media, etc.**
- **Common use of distributed network applications & services: online directories (white & yellow pages), robust electronic mail, distributed databases, etc.**
- **Full interconnection with national network infrastructures, especially the NREN**
- **Fully controlled access to NASA resources**

National Research & Education Network: Plan

The NREN will be a computer communications network that interconnects:

- educational institutions
- national laboratories, non-profit research institutions, and government facilities
- commercial organizations engaged in government-supported research or collaborating in such research
- unique national scientific and scholarly resources such as supercomputer centers, major experimental facilities, databases, and libraries

The NREN will provide high speed communications access to over 1300 institutions across the United States within 5 years.

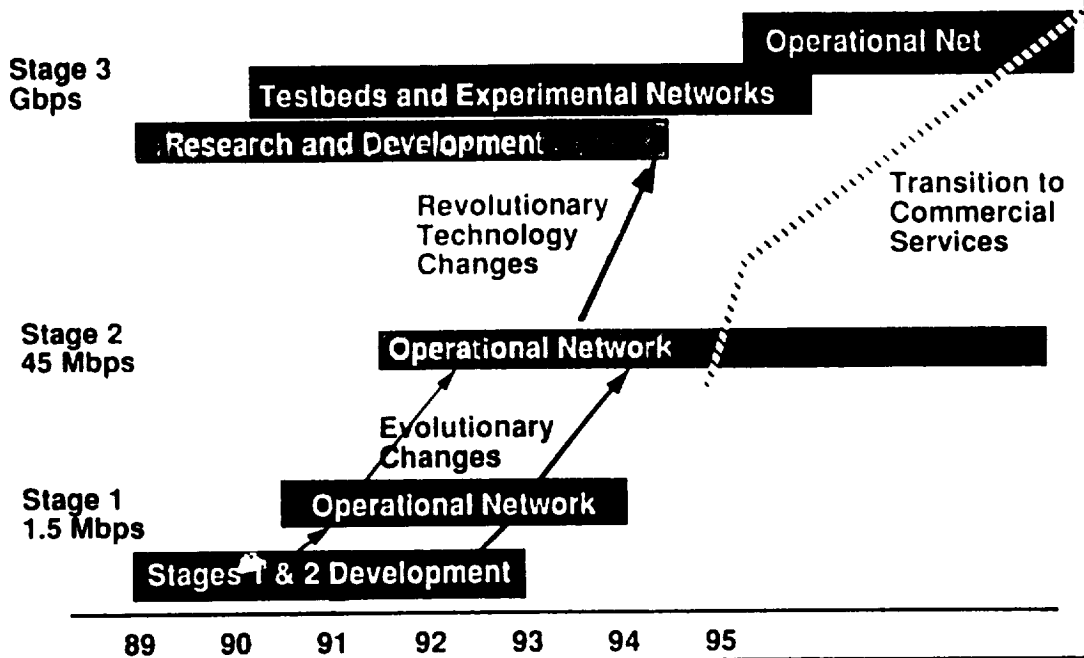
NREN Stages

Stage 1 - upgrades existing agency trunks to 1.5 Mbps

Stage 2 - combines multiple agency trunks into a shared 45 Mbps trunk system

Stage 3 - research & development phase to result in a shared national network with multi-gigabit-per-second trunks; technologies yet to be developed.

NREN Phases





***Planning Office Status Report
NSIUWG Meeting Greenbelt, MD***

March 31, 1992

John H. Martin

**NASA Science Internet Office
Information and Communications Systems Division
AMES RESEARCH CENTER**



Overview

I. Organization

II. Services Provided

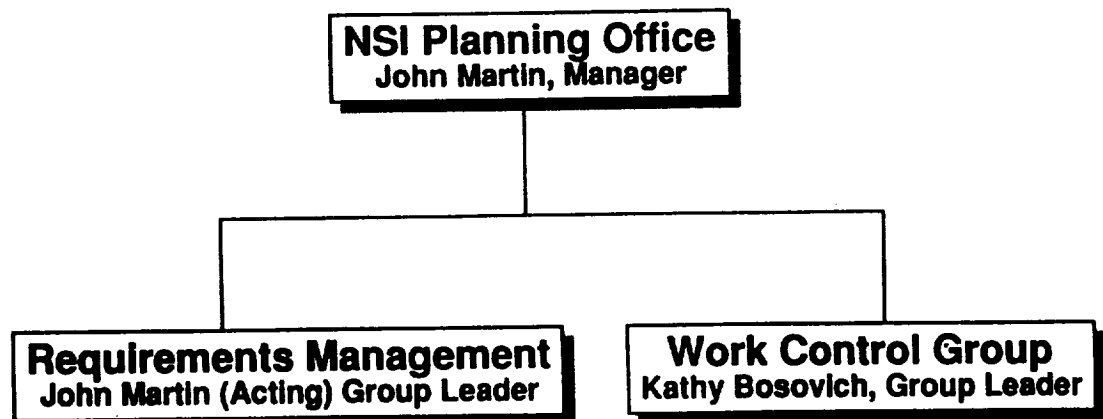
III. OSSA Requirements Profile

III. Highlights and Future Growth

NASA Science Internet Project

John H. Martin 2

Planning Office Organization



Requirements Management Group

Provide "Customer Service" to OSSA Scientific User Community

Define, Document, and Report all OSSA Communication Requirements

Manage Requirements Throughout Entire Process

Draft and Facilitate MOUs with Disciplines

Plan Future Networking Requirements with Disciplines

Involved with Planning and Development of OSSA Integrated Scientific Resources/Systems

Provide OSSA Conference Support and Outreach Activities

Work Control Group

Track OSSA Requirements and Manage Requirements Information

Provide Requirements Reporting Information Tools (charts, graphs, reports) to Increase NSI Responsiveness to OSSA Community

Provide Tracking and QA of NSI Internal Requirements Processing

Management of NSI Database Systems

Provide NSI Circuit and Reporting Information to Communications Carriers

Overall Tracking of NSI Processes and Procedures (i.e., validations, NSR, RFS, USR, outreach documentation)

**JOHN H. MARTIN, MANAGER
PLANNING OFFICE**

CODE	DISCIPLINE	REQUIREMENTS MANAGER	HQ VALIDATOR	ALTERNATE VALIDATOR
S	Office of Space Science and Applications	Maria Gallagher	Dr. Joseph Alexander	Mr. Rick Chappell
SB	Life Sciences	Shell Jones	Dr. Lawrence Chambers	Dr. Richard (Dick) Keefe
SE	Earth Science and Applications	Regina Duda	Mr. Ernest Lucier	Mr. Dixon Butler
SL	Solar System Exploration	JoAnn Nelson	Mr. Guentler Strobel	
SM	Flight Systems Division	TBD/John Martin	Dr. Phillip J. Cressy Jr.	
SN	Microgravity Science and Applications	Shell Jones/Maria Gallagher	Mr. Robert Schmitz	Ms. Mary Kicza
SP	Administration and Resource Management Division	TBD/John Martin	Mr. Scott Santiago	
SS	Space Physics	Maria Gallagher	Dr. James Willett	Mr. Louis Demas
SZ	Astrophysics	Elizabeth Feinler	Dr. Erwin Schmerling	Dr. Guentler Riegler
—	OSSA Conference Support	Halle Carlson	—	—

Overview

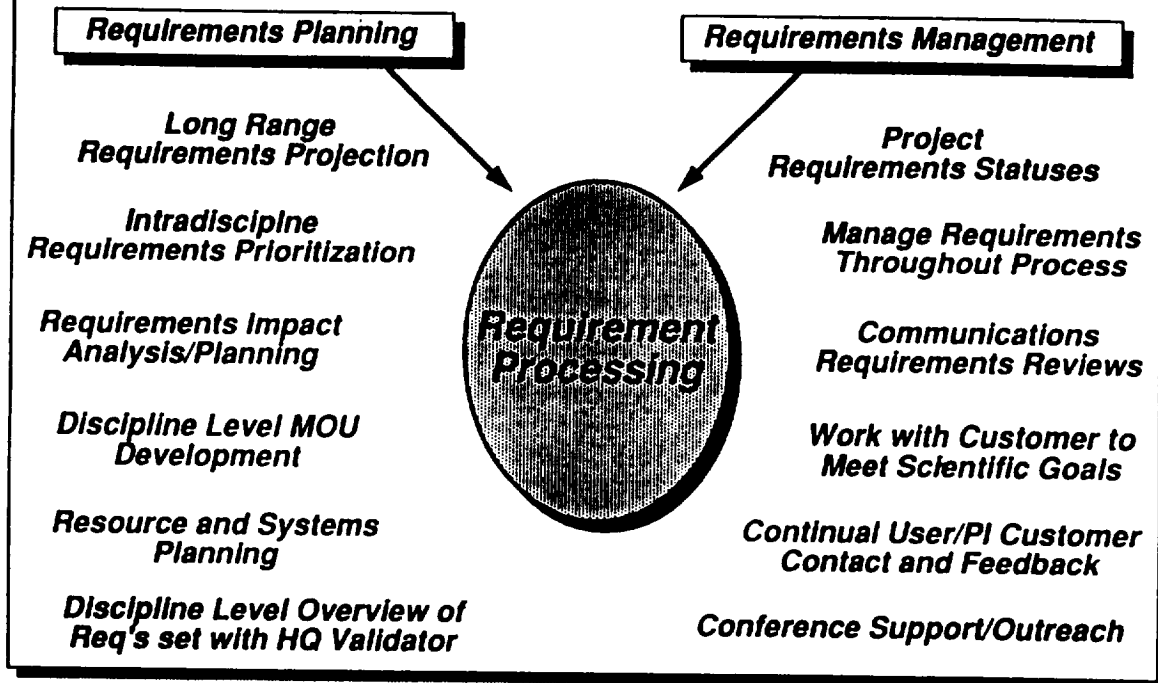
I. Organization

II. Services Provided

III. OSSA Requirements Profile

III. Highlights and Future Growth

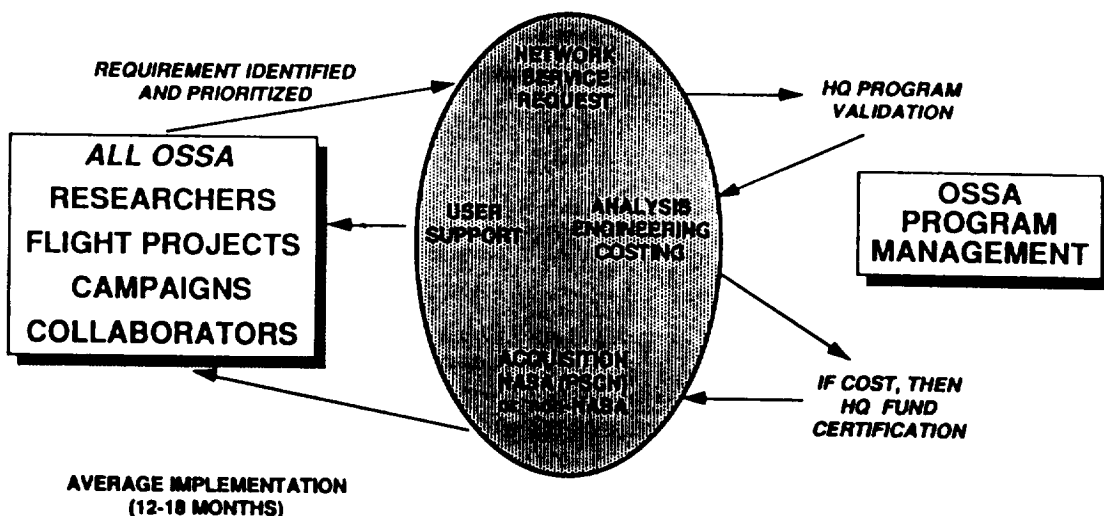
Planning Office Services



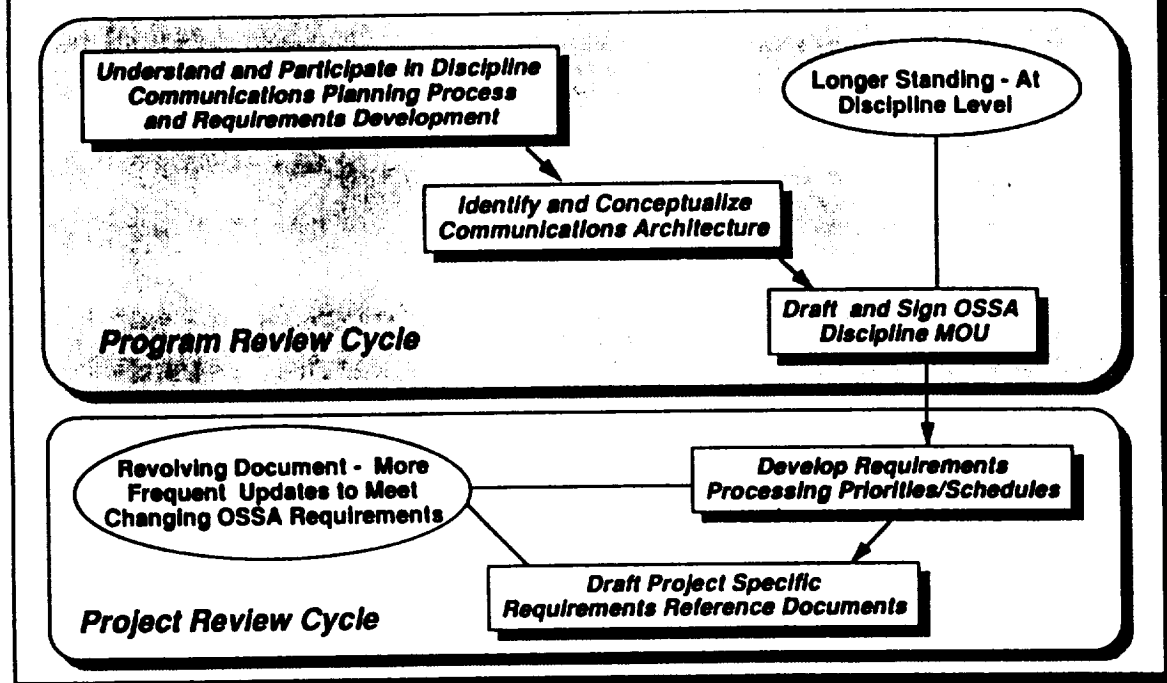
Requirements Processing

"Coordinating and assuring requirements are met"

NASA SCIENCE INTERNET



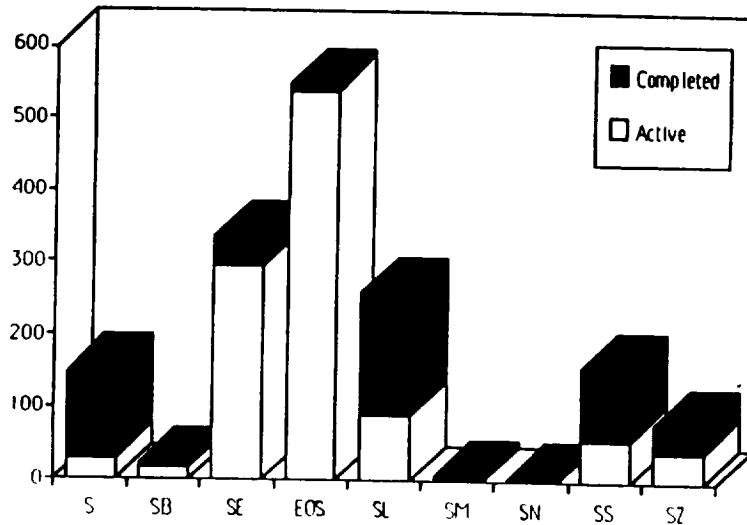
MOU Development Process



Overview

- I. Organization**
- II. Services Provided**
- III. OSSA Requirements Profile**
- III. Highlights and Future Growth**

OSSA Current Requirements

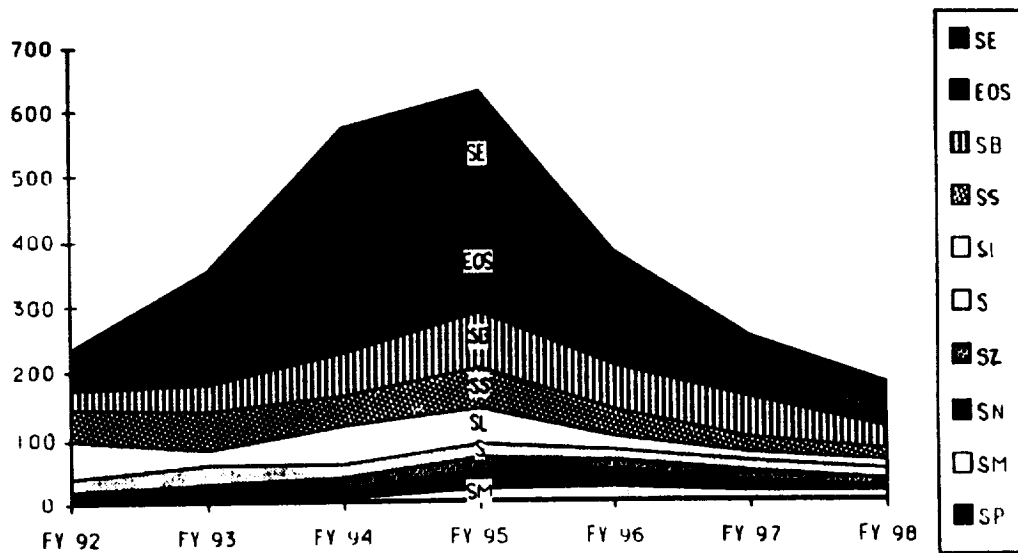


NSI OSSA Requirements Complement

Code S	Office of Space Science & Applications	148
Code SB	Life Sciences Division	21
Code SE	Earth Science & Applications Division	886
Code SL	Solar System Exploration Division	260
Code SM	Flight Systems Division	8
Code SN	Microgravity Science & Applications Division	4
Code SP	Administration and Resource Mgmt Division	0
Code SS	Space Physics Division	158
Code SZ	Astrophysics Division	82

TOTAL number of OSSA requirements: 1567

OSSA Projected New Requirements



Overview

I. Organization

II. Services Provided

III. OSSA Requirements Profile

III. Highlights and Future Growth

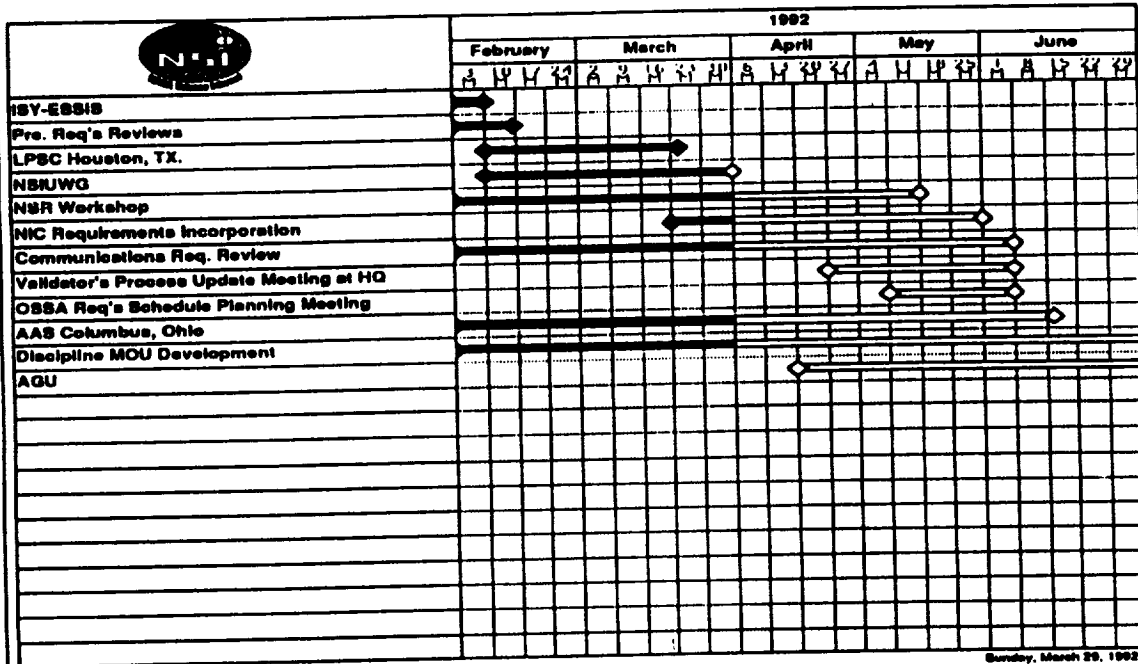
Planning Office Highlights/ Improvements

Increased Requirements Management Staff to Offer Better Level of Service
Begun Movement Towards "Discipline Level" MOUs
Integrated Work Control Group within NSI Planning Office
Further Refined Conference Support Policy and Requirement Documentation/Tracking
Improved Validation Time Through Requirements Managers and WCO
Greater Emphasis on Planning Effort (Projecting, Scoping, etc.)
Increased Capacity to Process and Manage Requirements

Planning Office FY 92 Activities

**Refine and Update NSR Process Through NSR Workshop -
Look to Include Cost Weighting and NIC Requirements**
**Look to Increase User Services/NIC Requirements Definition/Tracking
Effort to Incorporate into Existing OSSA NSR Process**
Increase Requirements Manager's Outreach to Scientific Community
Redesign MOU Process to Develop Discipline Level MOUs
Step-up Planning Efforts with HQ Disciplines - Schedule Requirements
Continue Outreach and Conference Support Effort
Increase User Feedback and Quality Service Mechanisms/Measurements
Hold Communications Requirements Reviews Annually
Standardize Requirements Reporting Format

Planning Office Schedule



Sunday, March 29, 1992

NASA Science Internet Engineering Status Report

**March 31, 1992
NSIUWG**

**Jeffrey G. Burgan
NASA Science Internet Office
NASA Ames Research Center**

Engineering Highlights

- **Backbone circuits upgraded to T1**
ARC, GSFC, JPL, LaRC, MSFC
JSC - JPL (448Kb)
NASA HQ (448Kb)
- **OSI (CLNP and IS-IS) capabilities deployed**
- **DECnet Phase IV routing enabled on the backbone**
ARC, GSFC, JPL, JSC, MSFC
- **Phase 1 of DECnet circuit upgrades to 56K completed**

Engineering Highlights (cont.)

- **Arizona DECnet consolidation completed**
via T1 to University of Arizona
- **Colorado DECnet consolidation currently being implemented**
via T1 to NCAR, Boulder, CO
- **DECnet routing implemented between NSI and ESnet**
at both FIX interconnects
- **Upgraded circuit to Univ of Alaska, Geophysical Institute**
PSCN provided T1 to be shared with EOS V0 network
- **NSFnet access being upgraded to T3**

International Access

- **NASA/ESA Connectivity**
 - NSI connectivity to ESAnet via NASA/PSCN links
 - ESOC (256Kb)
 - ESTEC (576Kb)
 - Currently supports IP routing
 - DECnet IV routing being implemented
 - PSCN upgrading links in June
- **United Kingdom**
 - Univ of London (128Kb)
 - Oxford University (128Kb)
 - Rutherford Appleton Lab (64K)

International Access (cont.)

- **PACCOM (Pacific Rim)**
 - Univ of Hawaii (1.5Mb)
 - Australia - AARnet (512Kb)
 - New Zealand (64Kb)
 - Hong Kong (64Kb)
 - Japan (multiple circuits)
- **Chile - Cerro Tololo Inter-American Observatory (56Kb)**
- **Greenland - Sondrestrom Radar Facility (56Kb)**
- **Antarctica - McMurdo Station (56K)**

Network Operations

- Network Operations Center (NOC) located at ARC
- 24 hour / 7 day availability
- Toll free international access
- Network management of routers using SNMP (Overview)
- Monitoring of DECnet circuits using NICE (custom program)
- Evaluating DEC MSU to provide integrated IP and DECnet management capability

Network Configuration

- 112 sites connected
 - 71 using multi-protocol routers
 - (54 routing DECnet Phase IV)
 - 29 using DEC's DDCMP
 - 12 utilizing DECnet encapsulation
- 2 interconnections with other Federal Agency Network's (NSFnet, ESnet, TWBnet, MILnet)
 - FIX-East (SURAnet, College Park, MD)
 - FIX-West (NASA Ames)
- Traffic increased 250% during past 12 months

NASA Science Internet (NSI) User Support Office (USO) Objectives and Recent Accomplishments

J. Patrick Gary
Science Network Office
Code 930.6
Goddard Space Flight Center

March 31, 1992

Presentation to the
NASA Science Internet User Working Group (NSIUWG) Conference



NASA Science Internet User Support Office

Objective

- Meet user needs for NSI information and applications services through the establishment and coordination of an effective set of Network Information Center (NIC) and network applications development efforts.

Key Functional Activities

- NIC Requirements Definition and Analysis
- Network User Help Desk
- Publications/Documentation
- On-Line Services
- User Outreach



NASA Science Internet User Support Office NIC Requirements Definition and Analysis

Objective

- Collect and document NIC requirements in User Services Request (USR) form
 - Information services, e.g., Yellow Page NSI Resource Guide
 - Application services, e.g., IP-OSI Interoperability Gateway
- Identify existing or emerging products and applicable R&D efforts
- Identify remaining resources needed to meet users' requirements

Recent Accomplishments

- Drafted separate Information Service Request and Applications Service Request forms to facilitate:
 - Work planning
 - Progress/status reporting
 - Product documentation
- Reviewed justification and prioritization factors with NSI's Deputy PM, e.g.,
 - Extent of user demand
 - Who and which sites will use this service and how often
 - Availability of this service in other NICs
 - Maturity of the technology/products related to this service



NASA Science Internet User Support Office Network User Help Desk

Objective

- Maintain 8 hr/day x 5 days/week NIC help desk with >90% live phone response
- Respond to user requests
 - General network information
 - Referrals (e.g., to NSI NOC, other NICs)
 - Network user problem diagnosis
 - User node configuration/optimization

Recent Accomplishments

- On-going Help Desk operations routinely handling approximately 20 Email requests and 10 phone requests per week; over 90% responses to Email by close of business next day
- Assembling reference files covering a wide variety of topics (e.g., internetwork mail, online resources, the NSI-DECnet node database, the NPSS, etc.) for use in day-to-day operations
- Planned Help Desk improvements in NSI NIC-NOC coordination, cooperation and information exchange
- Initiated contact with NIC-related personnel at MSFC NPSS, Merit, NSFnet Network Service Center, SURAnet, THENet, and other Help Desks as part of inter-NIC liaison activities
- Co-chairing IETF User Documentation Working Group with near-term goal of improving internetworking bibliography



NASA Science Internet User Support Office Publications/Documentation

Objective

- Coordinate the development and distribution of quality documentation

Recent Accomplishments

- Prepared several new mini-guides designed to assist network users in better understanding various network commands and in accessing numerous on-line services
 - How to Access the NSI Online Network Aide (NONA)
 - The NSI-DECNET Node Data Base
 - Using the EAST Interoperability Gateway
 - Basic TCP/IP (Internet) Commands for DECnet/VMS Users
 - Using the File Transfer Protocol (FTP)
 - "Rules of Thumb" for Determining the Source of Electronic Mail
 - The MacSecure Anti-Virus Tool Kit for Macintosh Computers
- Planned contents for a NSI New User Packet, e.g.,
 - What is NSI
 - Various mini-guides
 - Internetworking bibliography
 - What is the NSI NIC, NOC, NSIUWG, ...
 - Glossary of basic networking terms
 - NSI Resource Guide



NASA Science Internet User Support Office On-Line Services

Objective

- Provide NSI users with easy on-line access to networking information and utilities

Recent Accomplishments

- Installed and configured NSINIC VAX 3400 running VMS and NSISRV DECstation 5000/200 running ULTRIX as NSI-dedicated computers for hosting on-line USO services
- Enhanced the NSI On-line Network Aide (NONA) system since its V1.0 release
 - Completed various menus/informational files previously under construction
 - Added "Hot News" feature to top menu
 - Updated Electronic Mail Matrix information; also added a "knowbot" to handle interactive user inquiries in this subject area
 - Upgraded the on-line problem reporter and comments subsystem
 - Designing and testing Version 2 of NONA



NASA Science Internet User Support Office On-Line Services (continued)

Recent Accomplishments (cont'd)

- Created the NSI File Cabinet and updated its informational holdings
 - Presently contains 39 directories, 1392 files
 - Major directories are IMAGE, MAC, NSINIC, RFC, and SOFTWARE
- Created NSI_DB as a replacement for the old SPAN_NIC Yellow Pages
- Continued approximately bi-monthly updates to the NSI-DECnet node data base
- Providing USENET News feed for several NSI-connected sites
- Created NSI Electronic Postal Facility/POBOX capability
 - Maintains various mailing lists to send announcements and bulletins
 - Presently supporting the following groups:
 - International Forum on the Scientific Users of Space Station (IFSUSS)
 - AAS High Energy Astrophysics Division (HEAD)
 - Applied Information Systems Research Program (AISRP)
- Developed IKI-NASA Gateway system (now planned to be shut off)



NASA Science Internet User Support Office User Outreach

Objective

- Present NSI capabilities and demonstrate network information and application services through active participation in user conferences, symposia, and Working Groups

Recent Accomplishments

- Provided significant planning for the annual NSI User Working Group Conferences
 - Edited Proceedings of the Second Annual NSIUWG Conference, February 11-14, 1991
 - Coordinated numerous arrangements for Third Annual NSIUWG Conference, March 30 - April 3, 1992



NASA Science Internet User Support Office

User Outreach (continued)

Recent Accomplishments (cont'd)

- Assisted in staffing the NSI booths at key scientific conferences, e.g.,
 - December 7-11 AGU conference in San Francisco, CA
 - January 12-16 AAS conference in Atlanta, GA
 - March 16-20 LPSC conference in Houston, TX
- Presented NSI User Support Services at various project working group meetings, e.g.,
 - March 10-12 EOSDIS DAAC User Services Work Group Workshop in Slous Falls, SD
- Provided network usage consultation and tutorials on NONA, the NSI File Cabinet, and several other on-line systems to over 800 NSI users
- Establishing process of contacting user representatives at newly-connected NSI sites



NASA Science Internet User Support Office

New User Requirements and Recommended Changes —

We're Receptive!

- At This Conference:
 - Discussion during Plenaries
 - Discussion during User Services Subgroup
 - Discussion during User Services Tutorial
 - Discussion at NSI NIC Exhibit Booth
 - Other...
- Anytime:
 - Call and/or Email and/or FAX Help Desk
 - Leave message in NONA comments/suggestion box
 - Other...



WHO YOU GONNA CALL?

NSI Network Information Center

**Code 930.6
Goddard Space Flight Center
Greenbelt, MD 20771**

**301-286-7251
(FAX) 301-286-5152**

**nsihelp@nic.nsi.nasa.gov
nsinic::nsihelp**





NSI SECURITY Update

**RON TENCATI
NSI SECURITY MANAGER
March 31, 1992**



NSI SECURITY UPDATE

HACKERS ON NSI:

HOW THEY GET IN:

- DIAL IN VIA ROLM LINES
- NPSS (X.25)
- TCP/IP OR DECNET NETWORK (NSI)

TYPICAL HACKER ACTIVITY:

- TRY TO GUESS PASSWORDS
- EXPLOIT GUEST ACCOUNTS THAT ALLOW OUT OUTBOUND ACCESS
- SEARCH FOR WORLD-READABLE SYSTEM FILES .
- USE NSI/OSSA SYSTEMS AS STAGING AREAS FOR FURTHER ATTACKS.



NSI SECURITY UPDATE

CURRENT VULNERABILITIES BEING EXPLOITED

- TFTP (Used if a node is a boot-server)
Allows files to be read/copied w/out specifying a userid/password
/etc/passwd
- GAINING ROOT ACCESS VIA EXPLOITING BUGS, INSTALLING TROJAN HORSE
BINARIES
- TRIVIAL PASSWORDS
- DEFAULT ACCOUNTS AND "r" COMMANDS



NSI SECURITY UPDATE

IMPROVING OVERALL SECURITY

- USE PASS-PHRASES
- REQUIRE PASSWORDS ON ALL ACCOUNTS
- ONE ACCOUNT PER USERNAME
- GENERATE AUDIT TRAIL (ACCOUNTING) DATA - REVIEW DAILY
- INSTALL PATCHES AS THEY BECOME AVAILABLE
- RUN SECURITY "TOOLKIT" SOFTWARE
UNIX: "COPS" VMS: "SPAN TOOLKIT"
- REPORT INCIDENTS WHEN THEY HAPPEN
- *Come to the Tutorials on Thursday!*



NSI SECURITY UPDATE

INCIDENT HANDLING

- DO NOT REPORT NASA INCIDENTS TO THE "CERT"
- USERS SHOULD REPORT ANY ANOMALY TO THEIR SYSTEM ADMINISTRATOR
- SYSTEM ADMINISTRATORS SHOULD REPORT ANY SECURITY INCIDENT TO THEIR DPI-CSO
- IF INCIDENT INVOLVES AN EXTERNAL SITE, REPORT IT ALSO TO NSI-SECURITY OFFICE, SECURITY@NSINIC.GSFC.NASA.GOV
- NSI SECURITY OFFICE ISSUES SECURITY BULLETINS TO NSI COMMUNITY VIA ROUTING CENTER MANAGERS AND NASA AIS CONTACTS



NSI SECURITY UPDATE

SECURITY ALERT DISTRIBUTION

• NSI ROUTING CENTERS

- ARC (Warren Van Camp, Milo Medin)
- GSFC (Dave Stern, Jerome Bennett, Rick Dunbar)
- JSC (Dan Anderson)
- JPL (Sandy George, Joe Wiclawek)
- MSFC (Sam Pizzano, Linda Porter)
- ESOC (Paul Hughes)
- KSC (Mark Juhr, Mark Mason)

• OTHER NASA CONTACTS

- SSC (Paula LeBlanc)
- LeRC (Steve Praht)
- LARC (Steve Derry)
- HQ (Janet Keys, Russ Davis)
- JTD (Rick Carr)

• OTHER NETWORK/SECURITY CONTACTS

- ESnet/DECnet (HEPnet)
- INFN (Italy)
- ISAS/NASDA (Japan)
- DAN (Canada)
- RIKEN (Japan)
- SPAN France
- European SPAN
- SDSC
- DOE/CIAC
- ESTEC
- DARPA/CERT
- FIRST (Int'l CERT Group)
- NSI-NOTIFY@NSIPO



NSI Acceptable Use Policy

SUMMARY:

NSI supports all NASA science flight missions, discipline research programs, and collaborating scientists at NASA Centers and elsewhere.
NSI is not to be used for private gain or profit.

SPECIFIC:

- 1) Use of NSI must be in support of official NASA programs; all user requests for NSI connectivity must be validated and supported by cognizant OSSA Discipline Chiefs.
- 2) Use of NSI to support coordination and administrative execution of OSSA research grants is permissible;
- 3) Use of NSI to support NASA research, related training, and associated technical activities at non-profit institutions of research and education is acceptable.
- 4) Use of NSI for commercial or intellectual gain by for-profit organizations is not acceptable, unless those organizations are using NSI to satisfy specific NASA contract or grant requirements.
- 5) Use of NSI for research or education at for-profit institutions will be reviewed on a case-by-case basis to ensure consistency with OSSA programs; lack of program approval will result in disconnection.
- 6) Use of NSI to gain unauthorized use of resources attached to NSI will result in disconnection and legal prosecution. NSI will make every attempt to implement precautions to safeguard against unauthorized use of NASA computers, databases, and other attached federal resources.
- 7) Use of NSI for the introduction of worms, viruses, Trojans, or other software which maliciously interferes with normal NSI operations is unlawful.



NSI Acceptable Use Policy

KEY POINTS:

- **NSI ≠ "The Internet"**
- **NSI Resources are for OSSA Support Only**
- **OSSA/NSI Users enjoy full network access**
- **Unauthorized use of NSI is unlawful**
- **Violators will be prosecuted**



NSI SECURITY UPDATE

CONTINUING INITIATIVES

- o **REVISED POLICIES**
- o **TOOLKITS (VMS & UNIX IN FY92)**
- o **IMPROVED INCIDENT RESPONSE MECHANISM**
- o **EDUCATION**



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B. NSI User Projects Plenary

**Upper Atmosphere Research Project (UARS)
Project Update**

**NSIUWG
April 1, 1992**

**Daniel S. DeVito
Code 430
UARS CDHF Manager**

Agenda

- **Background**
 - UARS
 - Ground System
 - NSI Support
- **Lessons Learned**
 - Performance
 - Engineering Support
 - Operations Support
 - Management

Background: UARS

- The UARS, deployed by Discovery on September 14, 1991, is the first of a series of observatories to be launched as part of the "Mission to Planet Earth" program.
- UARS carries nine complementary experiments performing three types of measurements as follows:

Composition & Temperature	CLAES:	Cryogenic Limb Array Etalon Spectrometer
	HALOE:	Halogen Occultation Experiment
	ISAMS:	Improved Stratospheric And Mesospheric Sounder
	MLS:	Microwave Limb Sounder
Winds	HRDI:	High Resolution Doppler Imager
	WINDII:	Wind Imaging Interferometer
Energy Input	PEM:	Particle Environment Monitor
	SOLSTICE:	Solar/Stellar Irradiance Comparison Experiment
	SUSIM:	Solar Ultraviolet Spectral Irradiance Monitor

Background: UARS (cont.)

- The UARS Science Team consists of 20 Principal Investigators at various International locations:

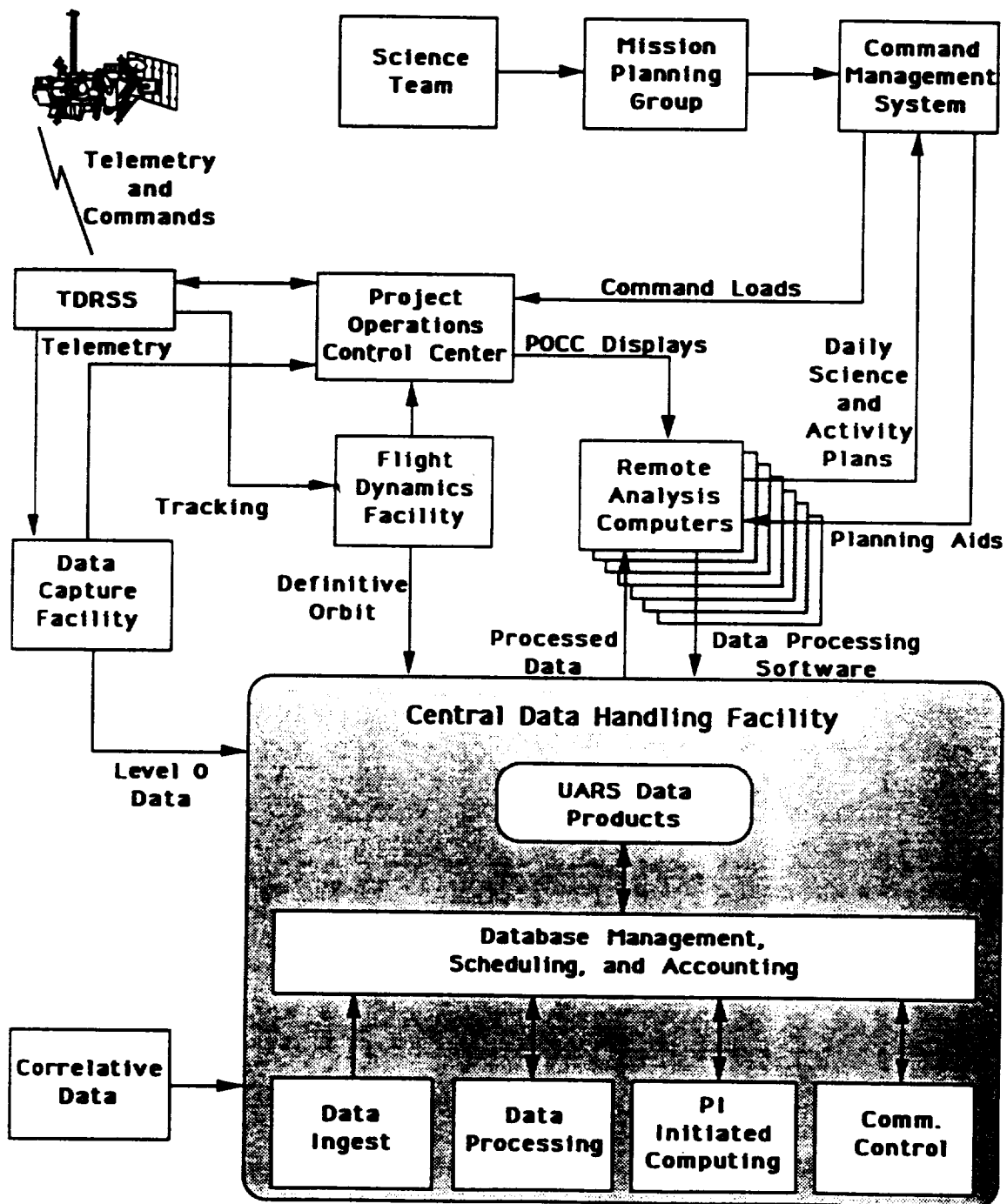
	Principal Investigator	Location	Instrument
Instrument Investigators	A. E. Roache	LPARL; Palo Alto, Ca	CLAES
	J.M. Russell	LaRC; Hampton, Va	HALOE
	F.W. Taylor	Oxford Univ.; Oxford, England	ISAMS
	J.W. Waters	JPL; Pasadena, Ca	MLS
	P.B. Hayes	Univ. Of Michigan; Ann Arbor, MI	HRDI
	G.G. Shepherd	York Univ.; Toronto, Canada	WINDII
	J.D. Winningham	SwRI; San Antonio, Tx	PEM
	G.J. Rottman	Univ. of Colorado; Boulder, Co	SOLSTICE
	G.E. Brueckner	NRL; Washington D.C.	SUSIM
Theoretical & Collaborative Investigators	D.M. Cunnold	Georgia Tech; Atlanta, Ga	
	M. Geller	SUNY; Stony Brook, NY	
	J. Gille	NCAR; Boulder, Co	
	W.L. Grose	LaRC; Hampton, Va	
	J.R. Holton	Univ. of Washington; Seattle, Wa	
	J. London	Univ. of Colorado; Boulder, Co	
	A.J. Miller	NOAA; Camp Springs, Md	
	C.A. Reber (Proj Sci)	GSFC; Greenbelt, Md	
	A. O'Neill	UKMO; Bracknell, England	
	D. Wubbles	LLNL; Livermore, Ca	
	R.W. Zureck	JPL; Pasadena, Ca	

Background: Ground System

- Instrument Investigator Teams provide daily science and activity plans to the Command Management System (CMS) based on planning aids.
- The CMS provides command loads to the Payload Operations Control Center (POCC) which are subsequently uplinked to the observatory via the TDRSS.
- Telemetry and Tracking data are downlinked to the Data Capture Facility (DCF) and Flight Dynamics Facility (FDF) via the TDRSS.
- The DCF archives the telemetry data, reverses the data to time-increasing order, removes redundant data, and decommutates and formats the data for transmission to CDHF.
- The CDHF provides non-critical mission support and data management functions:
 - Ingest UARS Level 0 data and correlative data
 - Process Level 0 data using PI-provided software
 - Store UARS data products and correlative data
 - Provide access to UARS data products and correlative data to UARS science community via network communications (managed by NSI).

Background: UARS (cont.)**• UARS mission lifetime**

	Flight Operations	Ground Data Processing Support
Original Plan	1.5 years	2.5 years
Current Plan	5 years	6/7 years



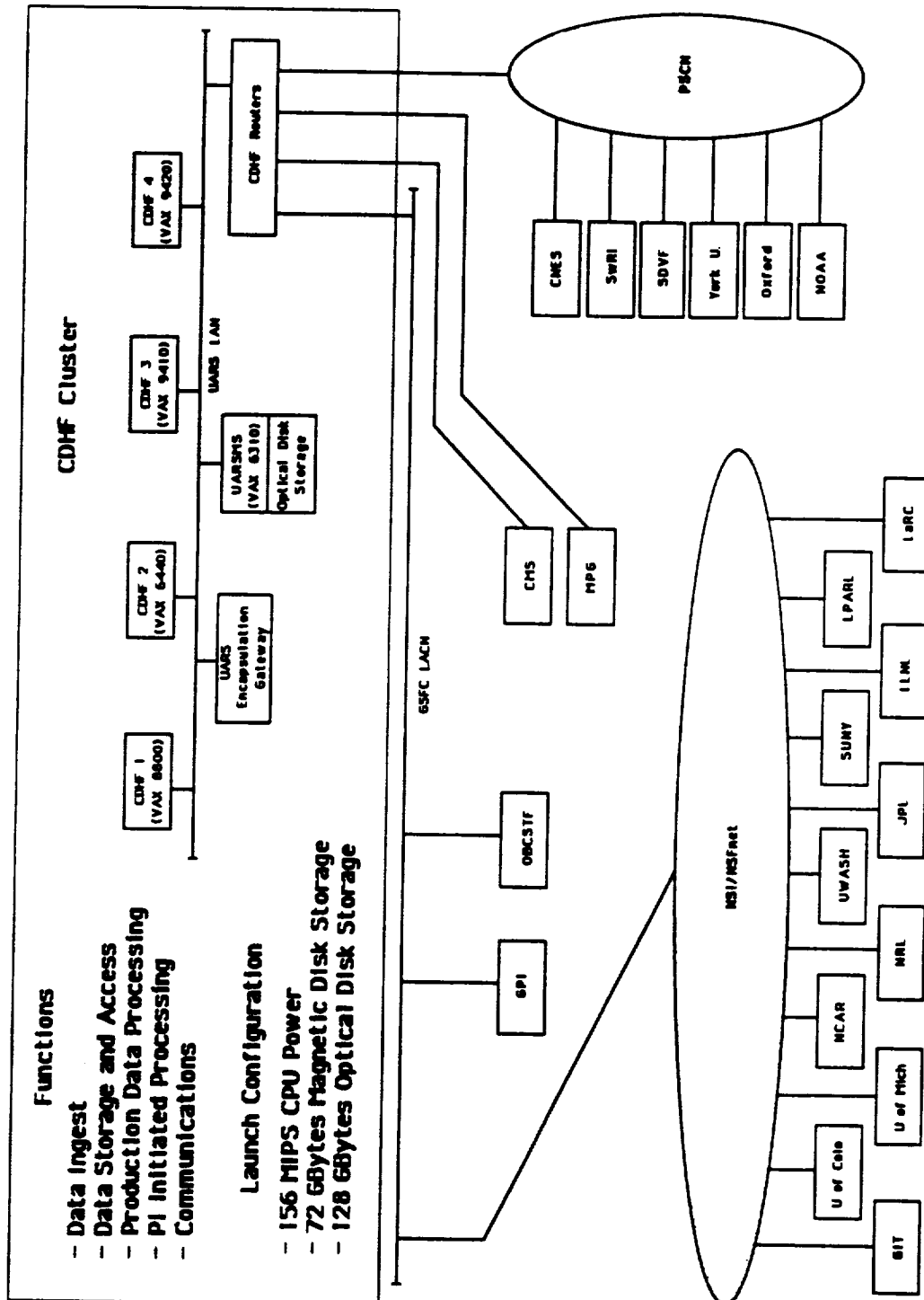
Background: Ground System (cont.)

- **UARS data available from the CDHF are:**
 - Level 0: pre-processed telemetry
 - Level 1: output of sensors (e.g., radiances)
 - Level 2: geophysical data (e.g., ozone mixing ratio, at footprint of sensor)
 - Level 3A: geophysical data transformed to a common format and interpolated to equal time and latitude steps (approximately one-minute centers)
 - Level 3B: latitude/longitude maps on a daily basis at one-half height intervals
- **Correlative data, supplied by Correlative Measurement Investigators (CMIs) via Pis, are available from the CDHF.**

Background: NSI Support

- **Engineer, reliable, DECnet connectivity between the CDHF and RACs**
- **Analyze external network reconfigurations and technology advancements for impact to the "UARSnet" (e.g. DECnet Phase V)**
- **Provide a minimum bandwidth equivalent to a 56 kbps dedicated circuit between the CDHF and each RAC**
- **Provide around the clock monitoring of all communication links**
- **Perform trend analysis on network links to monitor shared line utilization and track reliability, maintainability, and availability (RMA) of the "UARSnet"**
- **Report all line outages impacting the "UARSnet" and associated resolutions to CDHF operations and Project personnel**
- **Provide utilization statistics for each "UARSnet" link**
- **Present NSI status at the UARS Data Systems Working Group Meetings (DSWGs) and Systems Managers Meetings (SMMs)**

CDHF and UARSnet (Primary Circuits)



Lessons Learned: Performance

- Losses and subsequent acquisitions of communication links impacting COMF/RAC connectivity are reported by the NSI Network Operations Center (NOC) to UARS operations and Project personnel via e-mail. Each loss and gain of a link to a RAC is termed an "event".
- Events are categorized by cause as follows:
 - Line: outages caused by failure or planned maintenance outside the control of the RAC site
 - RAC: outage caused by failure or planned maintenance of RAC site
 - Unknown: outage reported by the NSI NOC but without sufficient information to determine cause
- E-mail messages from the NSI NOC were saved by the UARS Project for a period of 17 months (10/90-2/92) to use as a basis for trend analysis of the UARSnet performance. During the 17 months:
 - Over 1500 mail messages were sent to UARS by the NSI NOC concerning events
 - 731 events were recorded
 - Over 14% of all events were not completely reported by the NSI NOC and therefore are not used in the following performance statistics

Lessons Learned: Performance
UARSnet Event Statistics

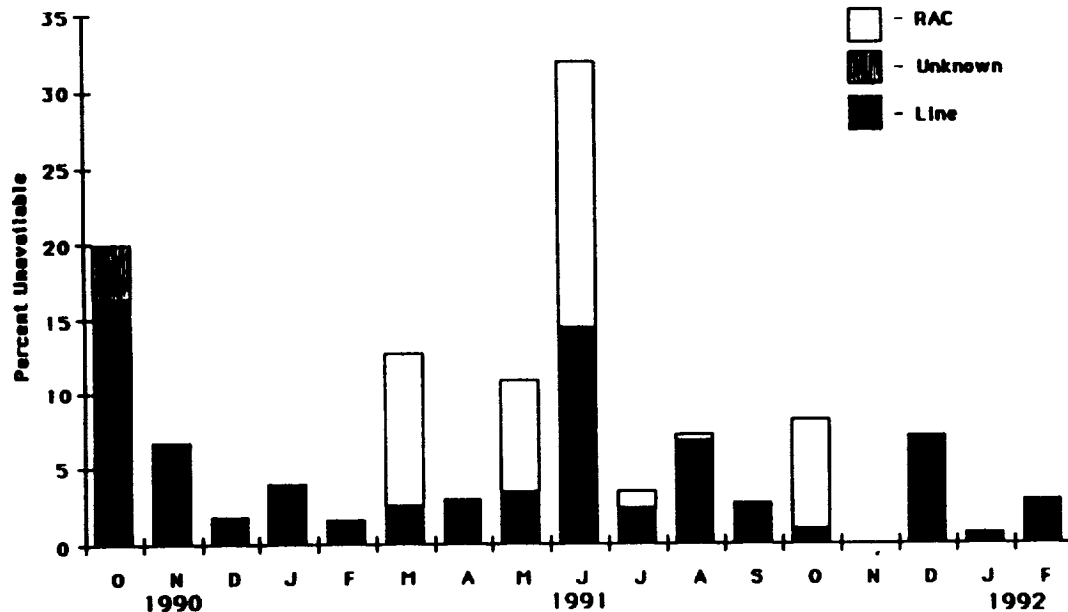
Location		Circuit Type	Number of Events			
			Line	Unknown	RAC	Total
NCAR	Boulder, Co	T1 (Shared)	22	14	24	60
NOAA	Camp Springs, Md	56 kbps (Dedicated)	2	2	3	7
LPARL	Palo Alto, Ca	T1 (Shared)	8	5	14	27
SUNY	Stony Brook, NY	T1 (Shared)	27	17	17	61
Ga. Tech	Atlanta, Ga	T1 (Shared)	12	6	15	33
LaRC	Hampton, Va	56 kbps (Dedicated)	19	5	13	37
LPARL	Palo Alto, Ca	56 kbps (Dedicated)	22	1	9	32
JPL	Pasadena, Ca	728 Kbps (Shared)	13	18	15	46
Oxford U.	Oxford, England	56 kbps (Dedicated)	6	5	9	20
SwRI	San Antonio, Tx	56 kbps (Dedicated)	39	3	18	60
U of Mich	Ann Arbor, MI	T1 (Shared)	14	15	21	50
NRL	Washington D.C.	T1 (Shared)	24	18	21	63
U of Wash.	Seattle, Wa	T1 (Shared)	6	5	14	25
U of Colo	Boulder, Co	T1 (Shared)	12	6	13	31
York U	Toronto, Canada	56 kbps (Dedicated)	5	13	7	25
CNES	Toulouse, France	56 kbps (Dedicated)	16	31	15	62
Total			247	164	228	639
Average			39	26	36	

Lessons Learned: Performance UARSnet MTBF/MTTR Statistics

Node Name	Location	Circuit Type	MTBF (Days)		MTTR (Hours)	
			Line	Total*	Line	Total*
ACDURS	Boulder, Co	T1 (Shared)	24.8	3.4	5.7	7.3
AIBROU	Camp Springs, Md	56 kbps (Dedicated)	181.1	24.5	10.7	11.0
CLAES	Palo Alto, Ca	T1 (Shared)	33.3	3.6	5.2	8.9
GELUA1	Stony Brook, NY	T1 (Shared)	9.2	1.8	3.2	3.7
GTUARS	Atlanta, Ga	T1 (Shared)	41.1	6.3	4.4	5.5
HALOE	Hampton, Va	56 kbps (Dedicated)	18.2	4.8	7.4	9.0
LPARS	Palo Alto, Ca	56 kbps (Dedicated)	21.3	5.7	4.3	6.3
MLSRAC	Pasadena, Ca	728 Kbps (Shared)	43.9	4.5	12.2	15.0
OXROU1	Oxford, England	56 kbps (Dedicated)	35.9	9.1	23.3	9.8
PEM	San Antonio, Tx	56 kbps (Dedicated)	12.0	2.9	12.5	15.1
SPRLJ	Ann Arbor, MI	T1 (Shared)	29.0	4.3	3.2	4.8
SUSIM	Washington D.C.	T1 (Shared)	18.9	3.3	8.0	8.8
UWASH	Seattle, Wa	T1 (Shared)	54.3	8.5	5.5	7.6
VIRGO	Boulder, Co	T1 (Shared)	35.2	6.7	1.4	5.1
WINDIC	Toronto, Canada	56 kbps (Dedicated)	96.4	6.7	2.8	6.6
WINDIF	Toulouse, France	56 kbps (Dedicated)	23.3	2.5	8.4	13.8
Average			42.4	6.2	7.4	8.6

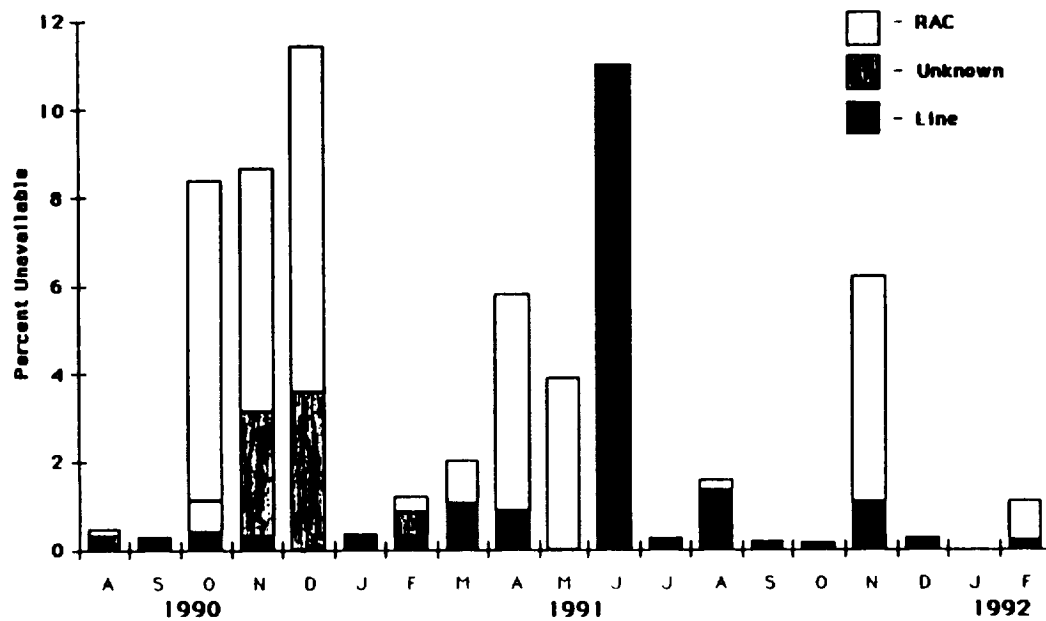
Note: "Totals" include outages caused by line, RAC or unknown

Lessons Learned: Performance CDHF-PEM (San Antonio, Texas)

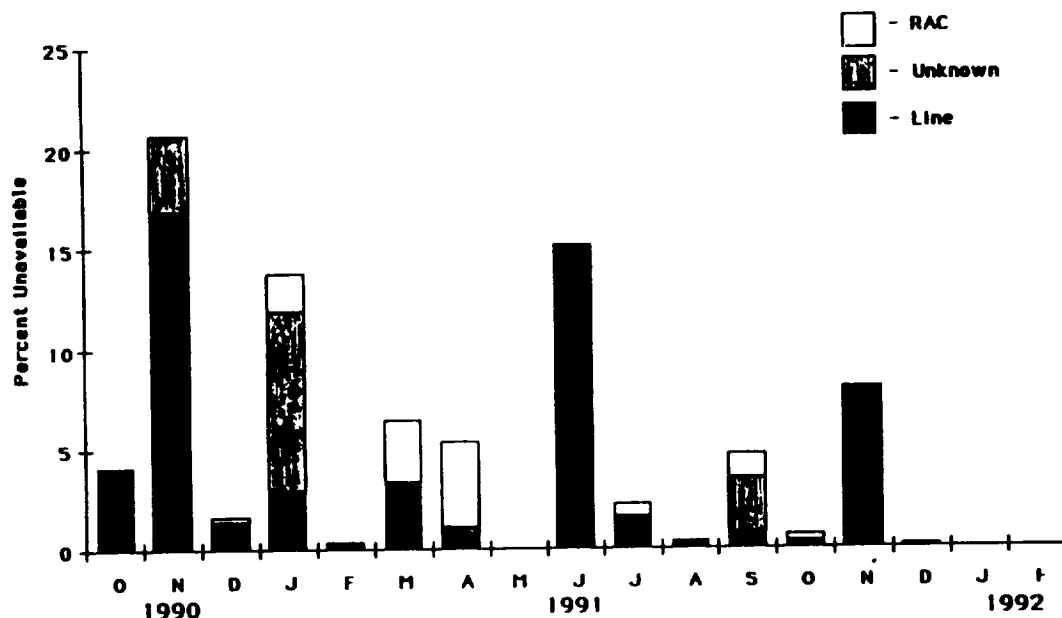


Note: 56 kbps Dedicated Link

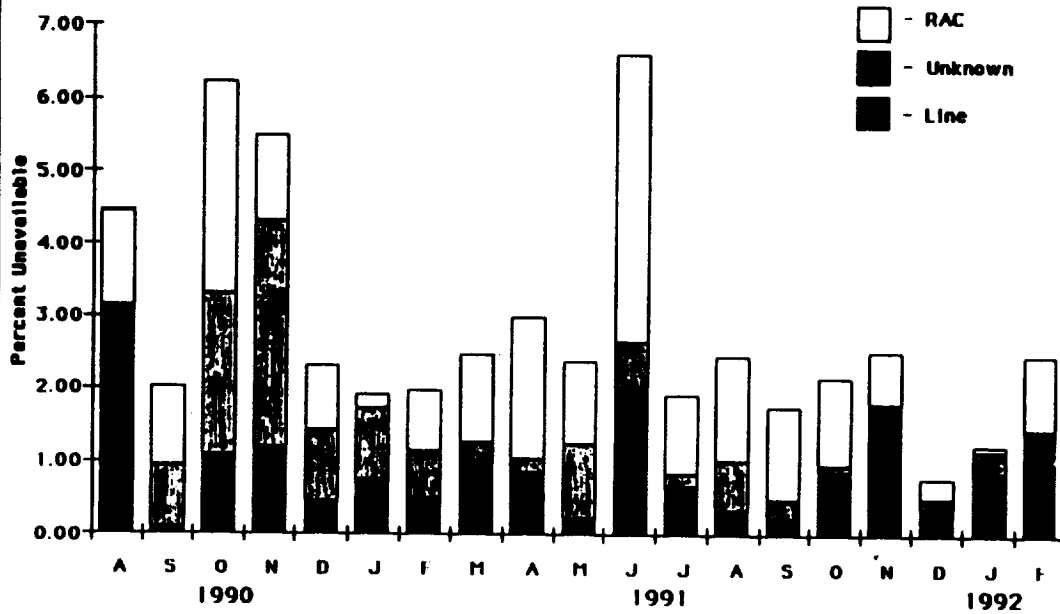
Lessons Learned: Performance CDHF-NCAR (Boulder, Colorado)



Lessons Learned: Performance CDHF-WINDIF (Toulouse, France)



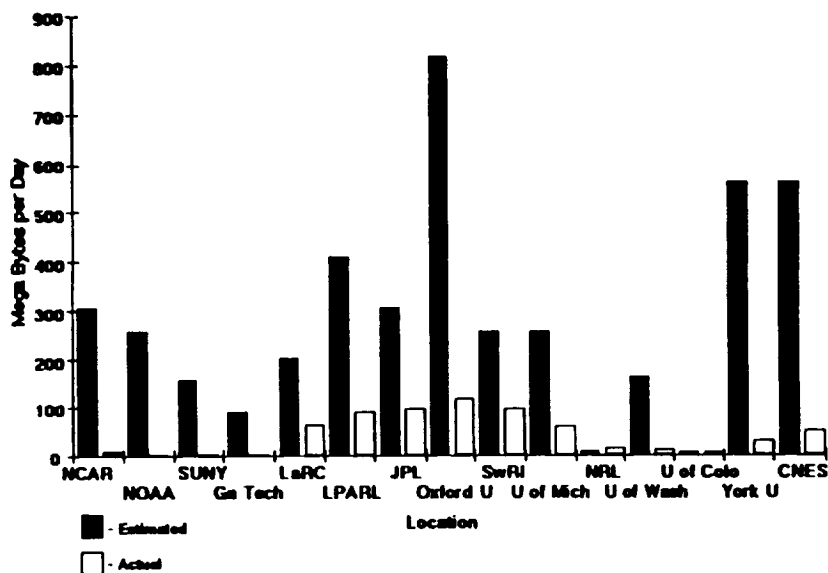
Lessons Learned: Performance Average of All CDHF-RAC Lines



Lessons Learned: Performance

- MTTR and MTBF appear to be closely tied to RAC location (as opposed to the type of service).
- The number of remote terminal sessions from the RACs to the CDHF was underestimated.
- Users tend to overestimate data transfer requirements (or underestimate the ability of the RAC to receive and properly archive data).
- Some users tend to expect near perfect reliability.
- Not all data products were available as soon as anticipated.

Lessons Learned: UCSS Data Transfer Load (During First Six Months) Estimated vs. Actual



Lessons Learned: Operations Support

- The NSI NOC needs to standardize "event" mail messages for easier tracking and to support trend analysis.
- Communication between the NSI NOC, CDHF/RAC Systems Managers, and Network Affiliates (e.g. PSCN, NSFnet) needs to improve in order to achieve accurate problem tracking and timely resolution of connectivity problems.
- The frequency of partially reported "events" has steadily improved.

Lessons Learned: Engineering Support

- NSIO engineering support has always been outstanding when directly applied to a UARSnet task.
- NSIO often has difficulty providing engineering support for the UARSnet in a timely manner.
- The UARS Project has not seen trend analysis performed as originally advertised by NSIO.

Lessons Learned: Management

- The UARS Project underestimated the effort required to coordinate with NSIO on networking issues.
- The NSIO underestimated the effort required to design, implement, and manage the UARSnet.
- NSIO has become more realistic in advertising services and task completion dates.
- NSIO Management response to UARS Project concerns was inadequate. The appointment of a Project Coordinator by NSI has greatly improved NSIO/UARS Project communication.

Galileo
THE SECOND EARTH ENCOUNTER

PRESENTED TO THE NSIUWG

Theodore C. Clarke
April 1, 1992

Production requirements and funding preclude the inclusion of Dr. Clarke's original color reproductions of Galileo images and maps.

THE SECOND EARTH ENCOUNTER

- HISTORICAL PERSPECTIVE
- VEEGA TRAJECTORY TO JUPITER
- VENUS, EARTH1, GASGRA ENCOUNTERS
- GALILEO SCIENCE DATA SYSTEM PREPARATIONS FOR EARTH2
 - BACKGROUND
 - RESOURCES
 - FIRSTS
 - THE NETWORK
 - SCIENCE VAX CLUSTER
 - SPICE
 - SCIENCE CATALOG
 - "AS RUN" SPACECRAFT EVENTS FILE
- EARTH/MOON2 SCIENCE OBJECTIVES
- EARTH/MOON CONJUNCTION MOVIE - A SIMULATION

Galileo

HISTORICAL PERSPECTIVE

- 4TH CENT. B.C. - EARTH CENTERED COSMOS OF ARISTOTLE
- 1543 - HELIOCENTRIC COSMOS OF COPERNICUS
- 1610 - GALILEO DISCOVERS THE MOONS OF JUPITER, SUNSPOTS, AND THE IMPERFECTIONS ON EARTH'S MOON, LEADING TO OVERTHROW OF ARISTOTLE'S MODEL OF THE COSMOS
- 1958 - NASA FORMED, EXPLORATION OF SOLAR SYSTEM BEGINS

Galileo

SCIENCE DATA SYSTEM - PREPARATIONS FOR EARTH2 BACKGROUND

- ORIGINALLY SCHEDULED FOR 1982 LAUNCH AND 1985 JUPITER ARRIVAL
- LAUNCH VEHICLE PROBLEMS DELAYED LAUNCH TO 1986 WITH 1988 ARRIVAL
- CHALLENGER ACCIDENT SLIPPED LAUNCH TO 1989 WITH VEEGA TRAJECTORY RESULTING IN JUPITER ARRIVAL LATE 1995
- TECHNOLOGY DEVELOPMENT/EVOLUTION DURING DELAYS WERE SIGNIFICANT
- GALILEO SCIENCE DATA TEAM FORMED IN 1986 TO IMPLEMENT/TAKE ADVANTAGE OF TECHNOLOGY IMPROVEMENTS
 - ELECTRONIC DATA DISTRIBUTION REPLACES TAPE DISTRIBUTION
 - SPICE REPLACES SEDRs
 - REAL-TIME DISPLAY CAPABILITY REPLACES PRINTOUTS
- "TARGETS OF OPPORTUNITY" ENCOUNTERS ON WAY TO JUPITER PROVIDE OPPORTUNITIES TO TEST EVOLVING SCIENCE DATA SYSTEM

Galileo RESOURCES

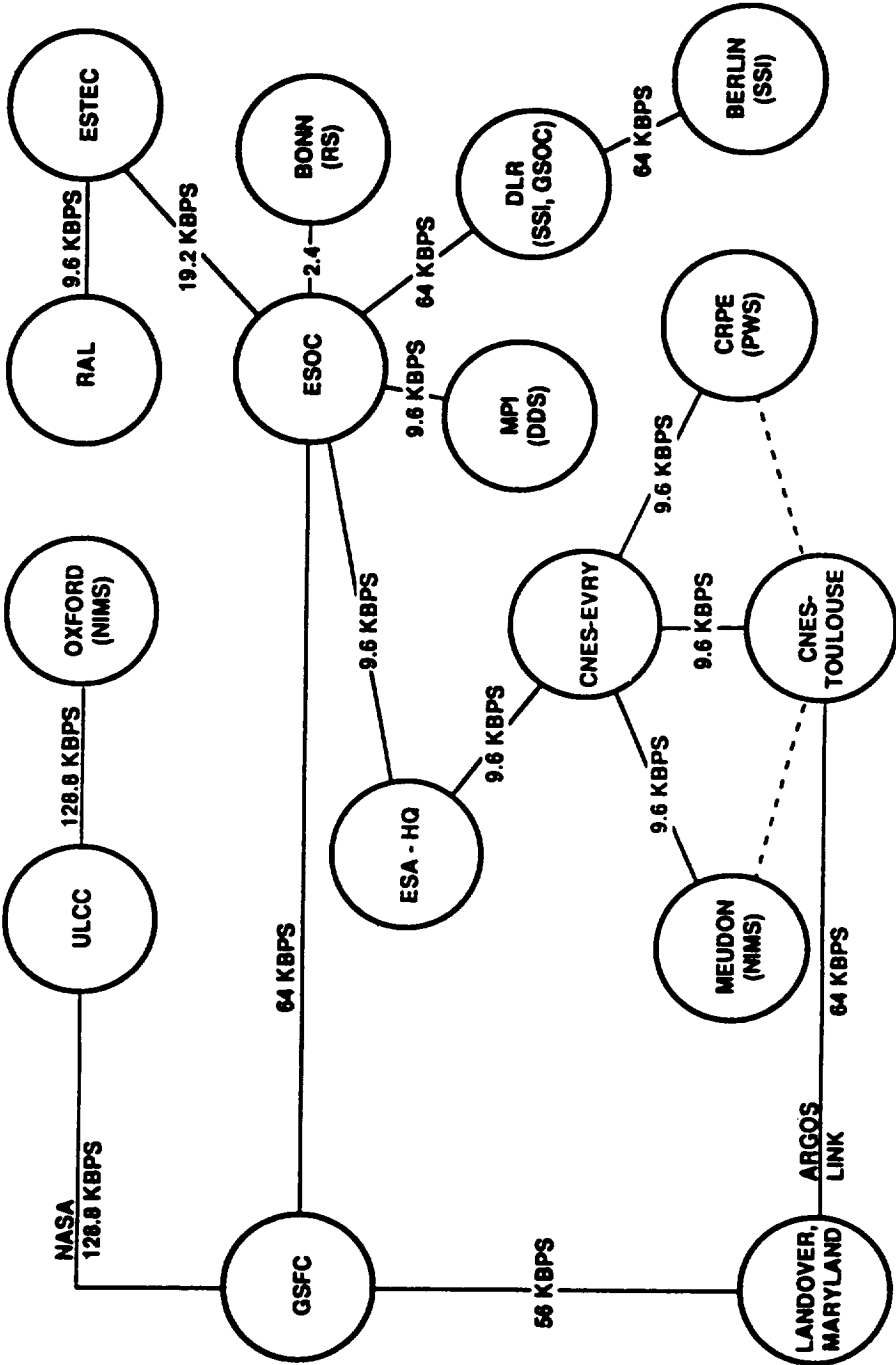
- MIPL VAX CLUSTER: 2 VAX 8650s, 2 VAX 11/780s
- SCIENCE VAX CLUSTER: 2 MICROVAX 4000s,
8 MICROVAX 3100s, 5 SUN SPARC STATIONS,
10 GBYTE ON-LINE DISC STORAGE, 600 MB R/W
OPTICAL STORAGE
- INGRES DBMS MIGRATING TO SYBASE, MULTINET S/W
TCP/IP IMPLEMENTATION, ROUTERS, TERMINALS,
PLOTTER, LASER PRINTERS
- SPICE ANCILLARY INFORMATION SYSTEM, ON-LINE
UPLINK PRODUCTS, SPICELIB TOOLKIT
- MAGPAC - MAGNETOSPHERIC OBSERVATION
PLANNING SOFTWARE
- 56 KBPS NETWORK, MOSTLY

Galileo
**ELECTRONIC COMMUNICATIONS AND DATA TRANSFER
NETWORK**

- NASA SCIENCE INTERNET T1 (1.5 MBPS) BACKBONE BETWEEN PRINCIPAL ROUTING CENTERS - GSFC, MFSC, ARC, JPL
- 32 REMOTE NODES, MOSTLY 56 KBPS TAILCIRCUITS
 - 23 DOMESTIC
 - 2 HAWAII
 - 6 EUROPE
 - 1 CANADA
- MULTIPROTOCOL - TCP/IP AND DECNET
- LOCAL PROGRAMMABLE ROUTERS PROVIDE 1ST LEVEL SECURITY AND PROTOCOL SELECTION
- EUA ROUTER PROVIDES HIGH LEVEL SFOC LAN SECURITY
- PERFORMANCE/CONNECTIVITY TESTS CONDUCTED BETWEEN GALILEO CENTRAL NODE (SVC) AND ALL REMOTE SITES
 - ASYMMETRIES DISCOVERED AND FIXES ADDRESSED
- TIMELY COMMUNICATIONS WITH NSI PROJECT OFFICE ENSURE UNINTERRUPTED SERVICE DURING ENCOUNTERS



Galileo



Galileo

Science Network Performance

Test procedure:

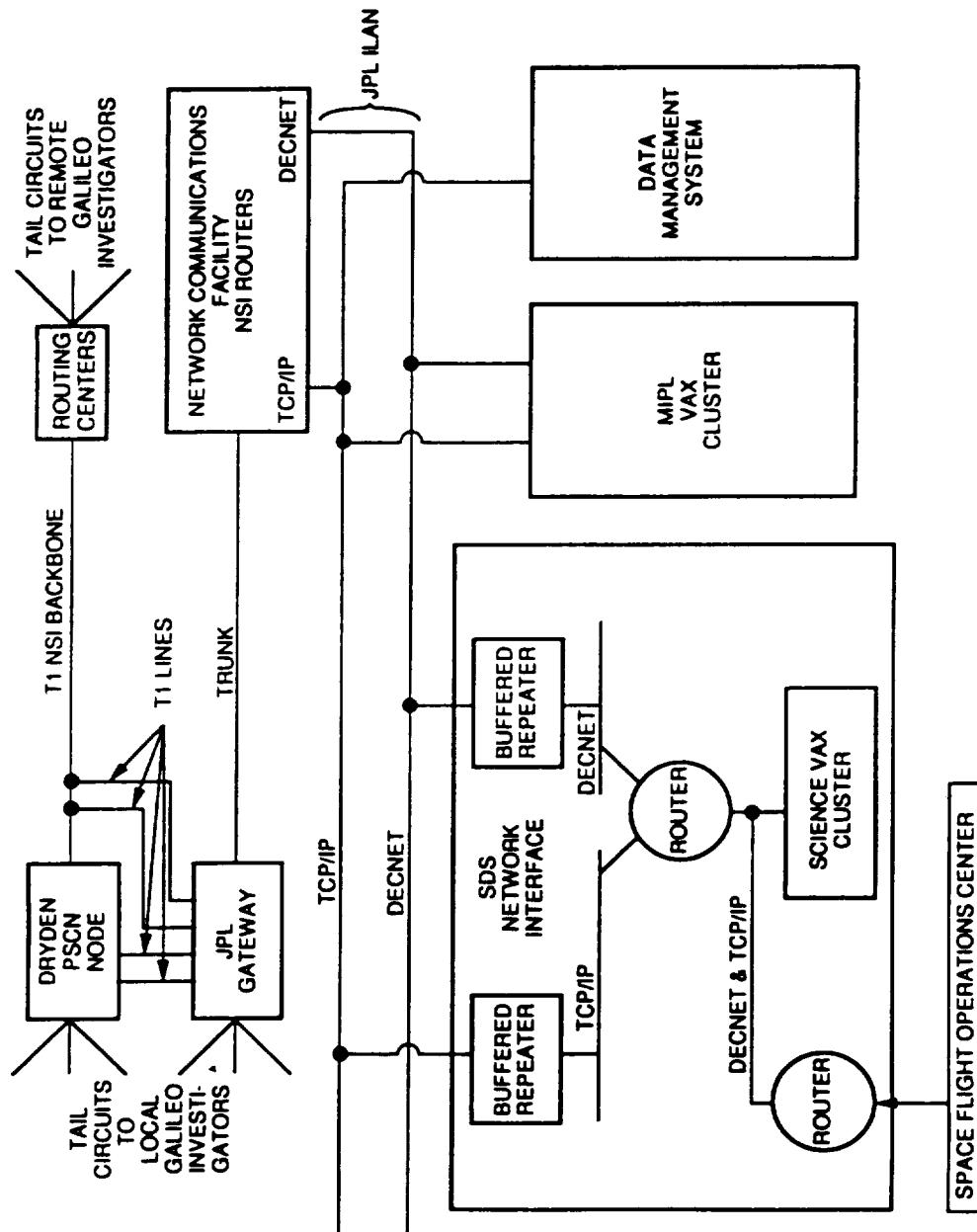
send/receive 800 records of 800 bytes each
calculate rates for each record transfer and
average transmission rates.

Results:

Brown University (PGGIPL)	Send: 35 kbps	Receive: 42 kbps
USGS - Menlo Park (MADMAX)	Send: 80 kbps	Receive: 107 kbps
University of Hawaii (UHCCVX)	Send: 119 kbps	Receive: 109 kbps
Germany/Oberpfaffenhofen (OOEPE5)	Send: 2.5 kbps	Receive: 3.0 kbps
France/Toulouse (CNESTA)	Send: 1.9 kbps	Receive: 2.9 kbps



SCIENCE DATA SYSTEM LOCAL AREA NETWORK INTERCONNECT AND INTERFACE TO THE NSI



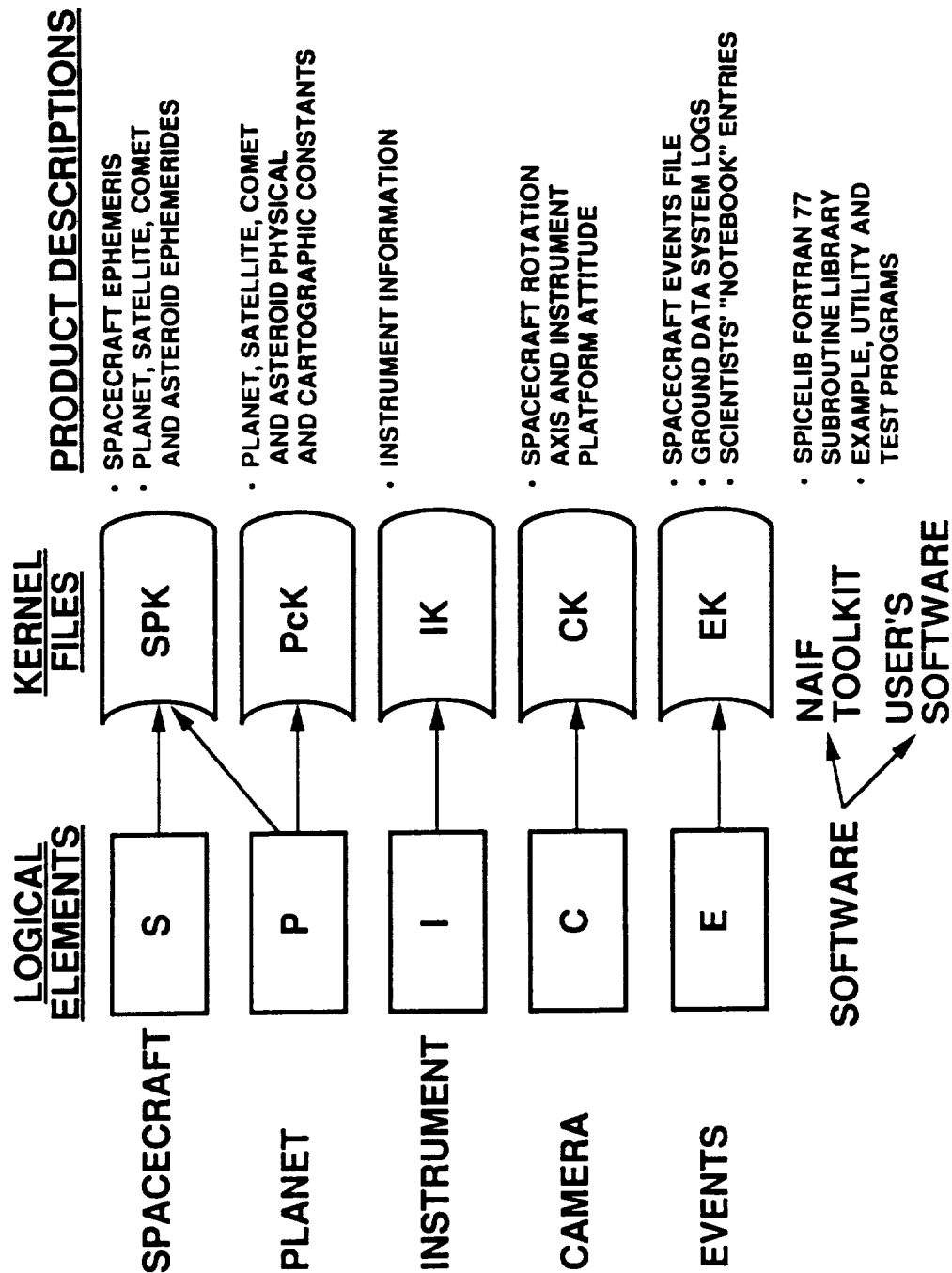
Galileo



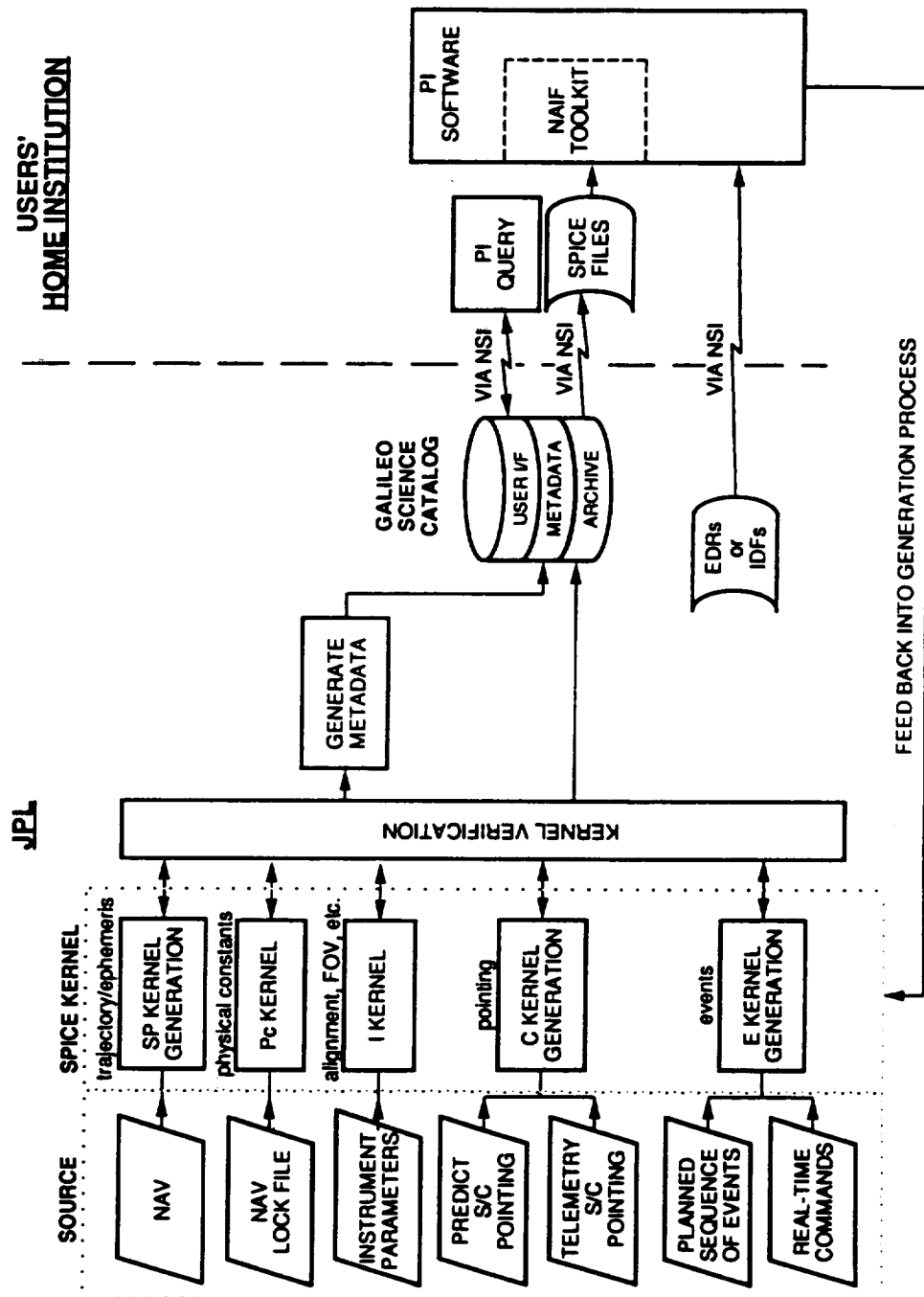
Gaileo
SCIENCE VAX CLUSTER

- **SERVER**
 - ELECTRONIC COMMUNICATION SERVICES FOR ALL SCIENCE TEAMS
 - TEMPORARY DATA STORAGE FOR LOW RATE SCIENCE
 - ELECTRONIC TRANSMISSION OF LOW RATE SCIENCE AND ANCILLARY DATA PRODUCTS
 - HOST FOR THE GLL SCIENCE CATALOG
 - HOST FOR ARCHIVE PRODUCTS TO BE DELIVERED TO THE PDS
 - HOST FOR SPICE KERNEL GENERATION, OPERATIONS, DATA AND TOOLKIT STORAGE AND DISTRIBUTION
 - TEMPORARY STORAGE OF UPLINK PRODUCTS FOR SCIENCE COORDINATOR AND PI TEAM REVIEW
- **CLIENTS**
 - HOST FOR CORRELATIVE DATA ANALYSIS FOR FIELDS AND PARTICLES SCIENCE, AND FOR MAGPAC
 - SUPPLEMENTARY SFOC INTERFACE UTILIZING PI SUPPLIED SOFTWARE FOR NERT PROCESSING

SPICE -- A BRIEF DESCRIPTION



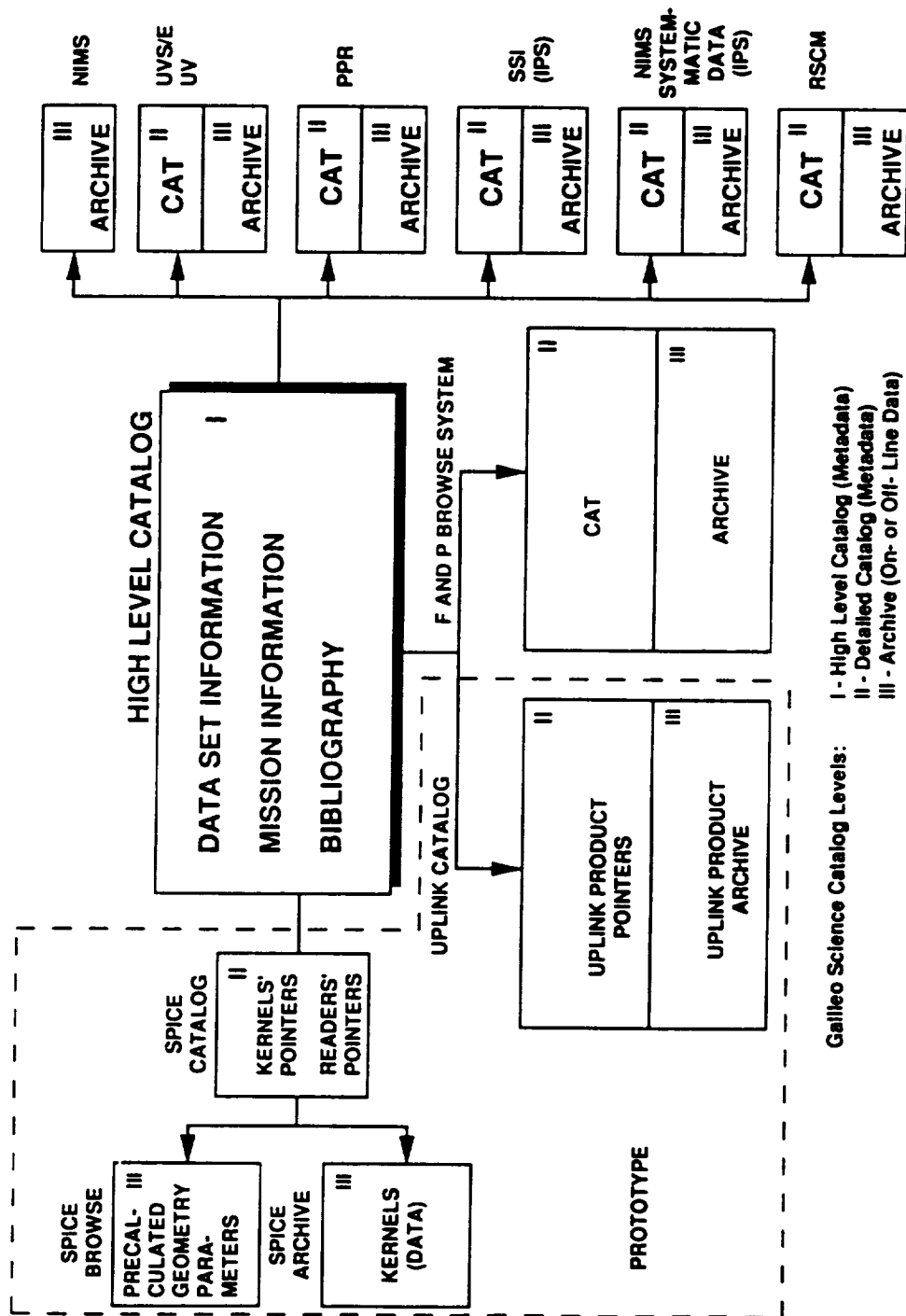
Galileo **SPICE SYSTEM DATA FLOW**



GALILEO SCIENCE CATALOG

- HIGH LEVEL CATALOG
- MISSION INFORMATION
- DATA SET INFORMATION
- BIBLIOGRAPHY
- SPICE CATALOG
 - KERNEL METADATA, DATA ARCHIVE, AND NAIF TOOLKIT
- UPLINK PRODUCTS CATALOG
 - ORBIT ACTIVITY PLAN ELEMENT DICTIONARY
 - ORBIT ACTIVITY PLANS
 - SPACECRAFT EVENTS FILES
 - INTEGRATED SEQUENCE OF EVENTS FILES
- INTERFACE TO FIELDS AND PARTICLES BROWSE SYSTEM
 - MODIFIED PDS PPI NODE F&P BROWSE SYSTEM
- PPR DETAILED CATALOG (DESIGN AND IMPLEMENTATION BY SDT)
- INGRES DBMS MIGRATING TO SYBASE FOR COMPATIBILITY WITH PDS, SFOC, MIPL
- SSI, NIMS, UVS, RS DETAIL CATALOGS BY SCIENCE TEAMS, WITH METADATA LINKS TO GSC

GALILEO SCIENCE CATALOG ARCHITECTURE



Gafleo

LUNAR SCIENCE OBJECTIVES AT EARTH2

- REMOTE SENSING COVERAGE OF THE LUNAR FAR SIDE FOR UNIQUE COMPOSITION AND MULTISPECTRAL CHARACTERIZATION, ILLUMINATED AND DARK - ALL REMOTE SENSING INSTRUMENTS
- REMOTE SENSING COVERAGE OF LUNAR NEAR SIDE "KNOWN" AREAS FOR CALIBRATION - ALL REMOTE SENSING INSTRUMENTS
- REMOTE SENSING COVERAGE OF LUNAR NORTH POLAR REGION FOR COMPOSITION AND MULTISPECTRAL CHARACTERIZATION - ALL REMOTE SENSING INSTRUMENTS
- BRIGHT/DARK LUNAR LIMB DRIFT SEARCHING FOR H, O, OH OUTGASSING - UVS, NIMS
- MEASURE RADIOMETRIC BRIGHTNESS VS WAVELENGTH AND POSITION ON THE LUNAR DISK - PPR AND NIMS



EARTH SCIENCE OBJECTIVES AT EARTH2

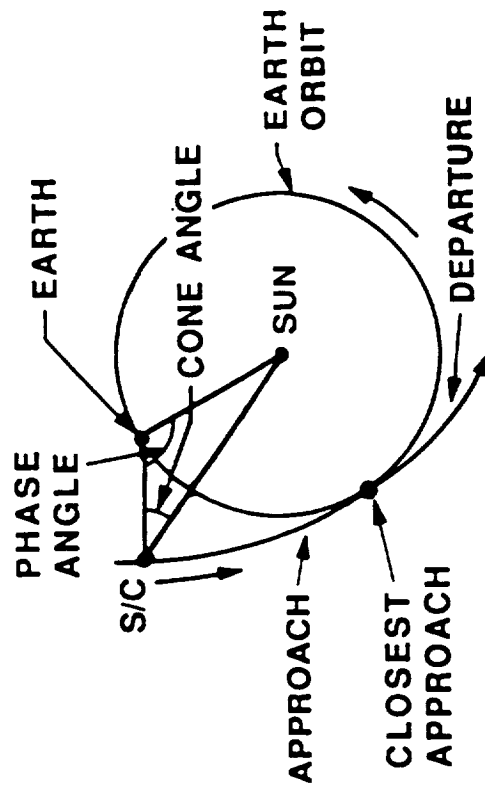
- DETECT/CHARACTERIZE POLAR STRATOSPHERIC CLOUDS - NIMS
- GLOBAL MOSAIC TO DETERMINE DISTRIBUTION OF GASEOUS SPECIES - NIMS
- CHARACTERIZE DYNAMICS OF THE PLASMA ENVIRONMENT IN THE EARTH'S MAGNETOSPHERE AND MAGNETOTAIL - ALL F&P, UVS
- SEARCH FOR AND CHARACTERIZE HIGH FREQUENCY FEATURES IN THE MAGNETOSPHERE AND BOWSHOCK - ALL F&P
- GROUND TRUTH SPATIAL RESOLUTION AND SPECTRAL MEASUREMENTS OF EARTH FEATURES FOR COMPARISON WITH OBSERVATIONS OF ASTEROIDS AND JOVIAN SATELLITES - SSI, NIMS, PPR
- MEASURE/CHARACTERIZE GEOCORONA - UVS
- MULTISPECTRAL OBSERVATION OF ANDES MOUNTAIN RANGE - SSI
- EARTH ZOOM/ROTATION MOVIE (C/A + 10HR TO 3D1HR) - SSI
- EARTH/MOON MOVIE, MOON PASSING EARTH (C/A + 8D TO 8D14H) - SSI
- DETECT SIGNS OF LIFE ON EARTH (VEGETABLE, ANIMAL, INTELLIGENT) - SSI, PWS



ADDITIONAL SCIENCE OBJECTIVES AT EARTH2

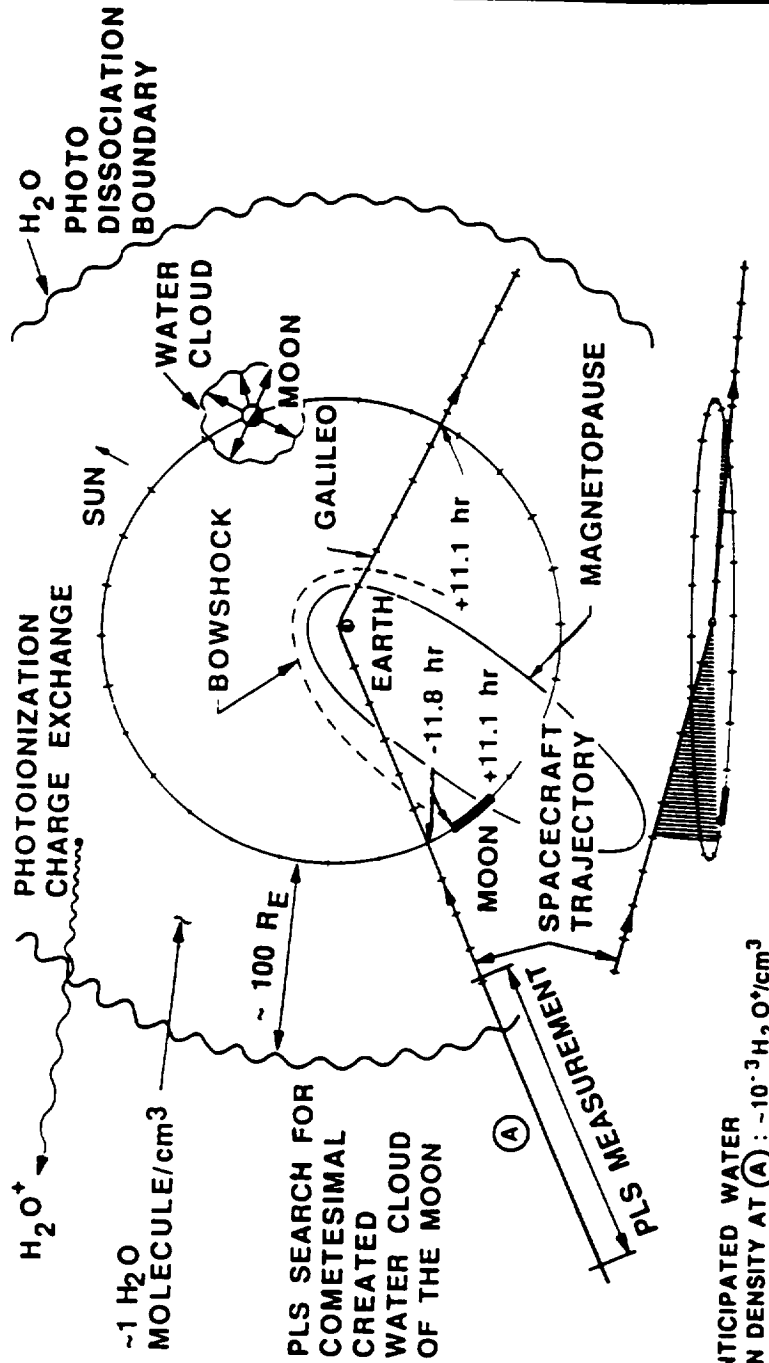
- SEARCH FOR EVIDENCE OF SMALL COMETS BY CONDUCTING MEASUREMENTS FOR MOLECULAR HYDROGEN AND WATER IN VICINITY OF THE MOON - UVS, PLS
- DEMONSTRATE OPTICAL COMMUNICATIONS OVER DEEP SPACE DISTANCES - SSI
- CHARACTERIZE TIME VARIABILITY AND DYNAMICS OF THE SOLAR WIND - ALL F&P
- OBSERVATIONS OF SOLAR FLARE RELATED EVENTS IN THE SOLAR WIND - PWS, EPD, MAG, HIC
- OBSERVATIONS OF EARTH CROSSING ASTEROID TOUTATIS - EUV

PHASE ANGLE AND CONE ANGLE OF THE EARTH DURING THE EARTH ENCOUNTERS



- DARKSIDE (HIGH PHASE ANGLE) APPROACH
- TERMINATOR CROSSING AT CLOSEST APPROACH
- LIGHTSIDE (LOW PHASE ANGLE) DEPARTURE
- CLOSING RATE ~ 750,000 KM/DAY
- SUN POINTED SPACECRAFT REQUIRES USE OF LOW GAIN ANTENNAS

LUNAR ORBIT TRAVERSE AT EGA2



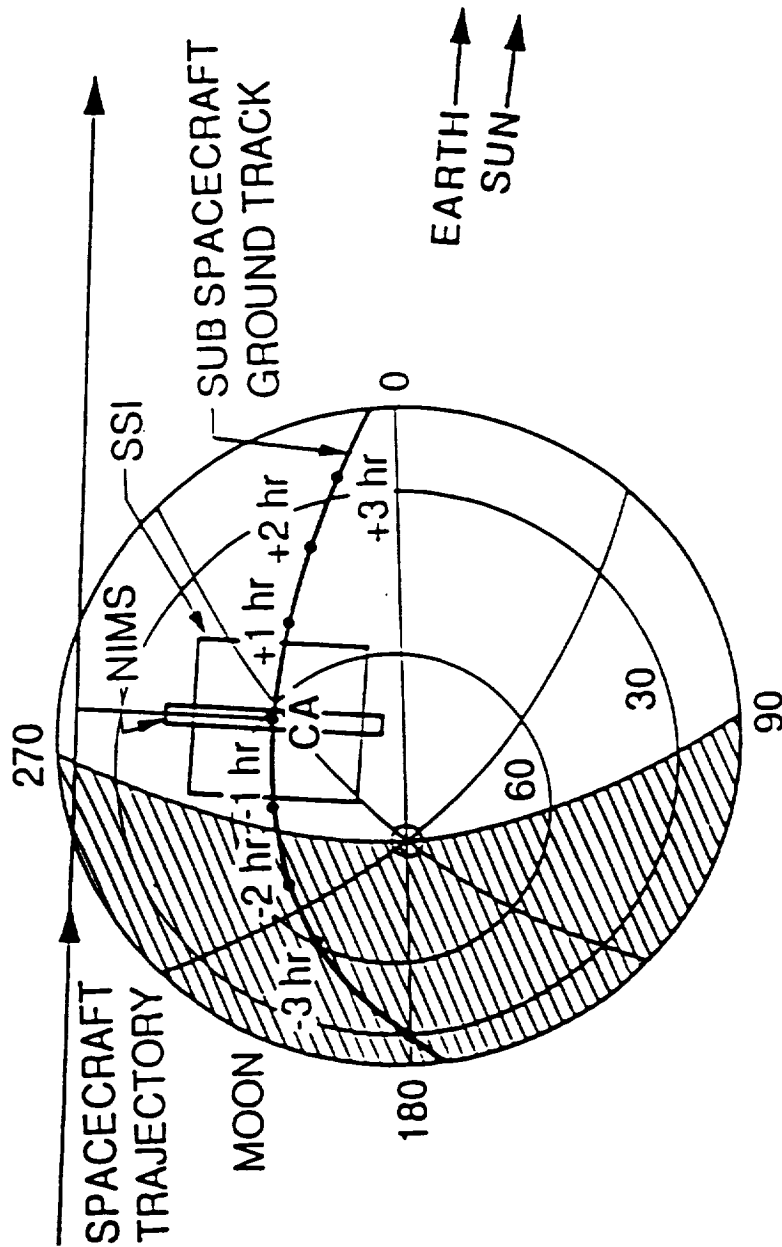
ANTICIPATED WATER
ION DENSITY AT (A) : $\sim 10^{-3} \text{ H}_2\text{O}^+/\text{cm}^3$

FLUXES (DIRECTIONAL, NO
THERMALIZATION): $\sim 10^5/\text{cm}^2 \cdot \text{sec}$ at 10 to 100 kev

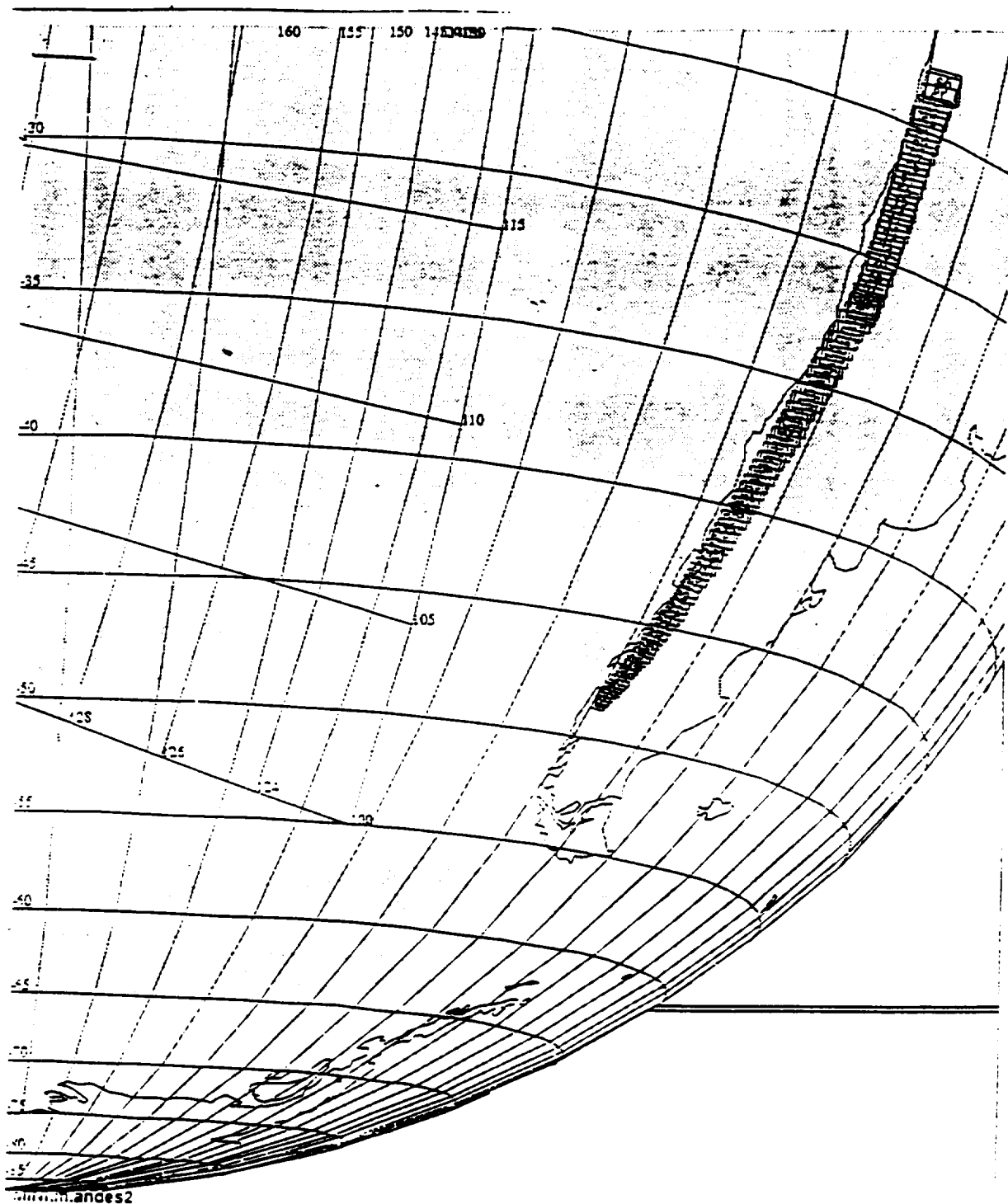
GALILEO PLS THRESHOLD: $\sim 10^4/\text{cm}^2 \cdot \text{sec}$ at 10 kev (COMPOSITION MEASURED)

Ref: Louis Frank, Presented at Galileo Earth/Moon Science Workshop, 5/10/88

LUNAR ENCOUNTER GEOMETRY AT EGA2 FOR 10/18/89 INJECTION



CLOSEST APPROACH ALTITUDE: 108,000 km



andes2

S/C EPH:gptr.eph/E2PLN-110791.t

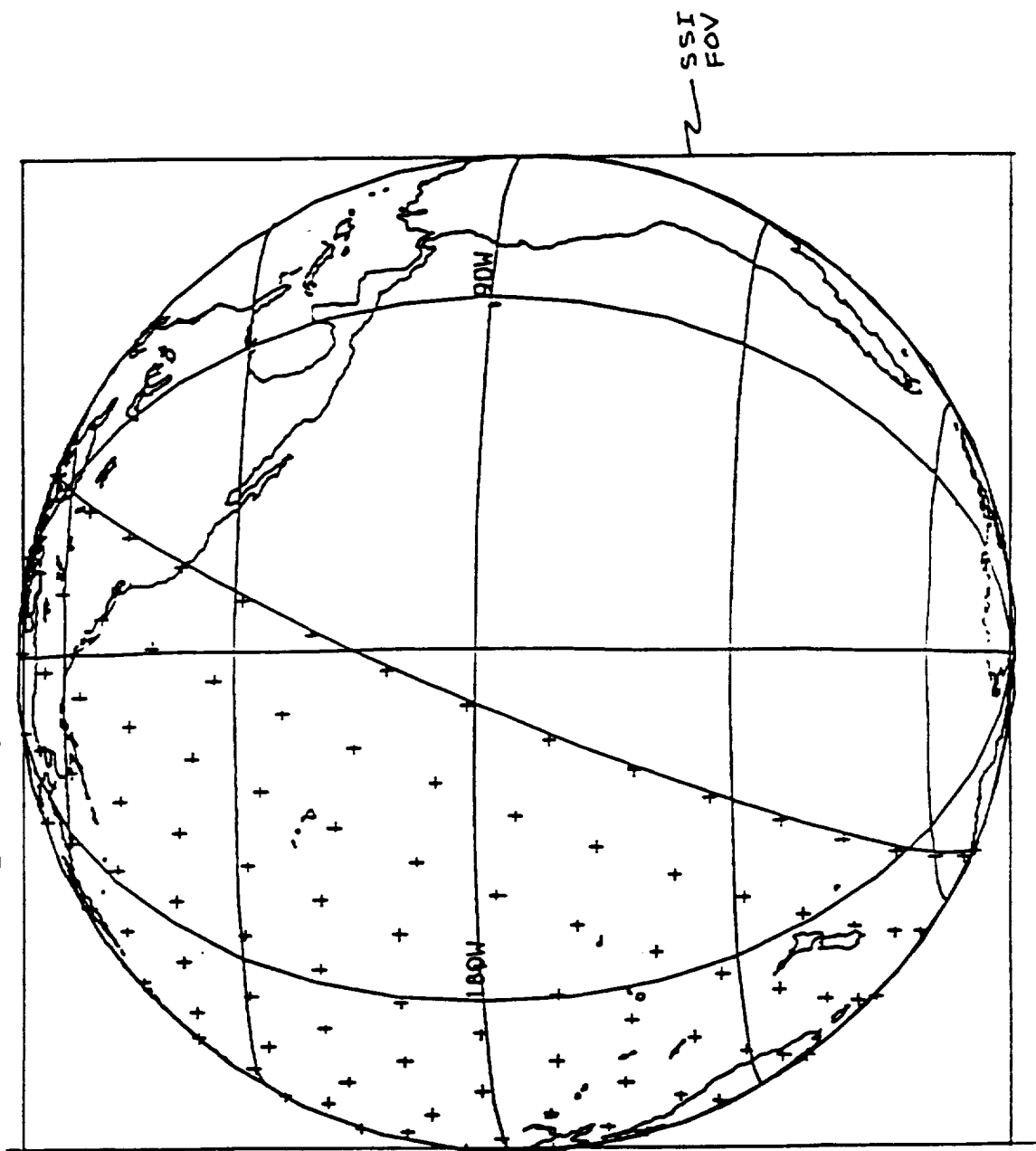
PERIAPSIS:92-343/15:10:23

START:ECA 92-343/15:09:24.816 -0/00:15:10

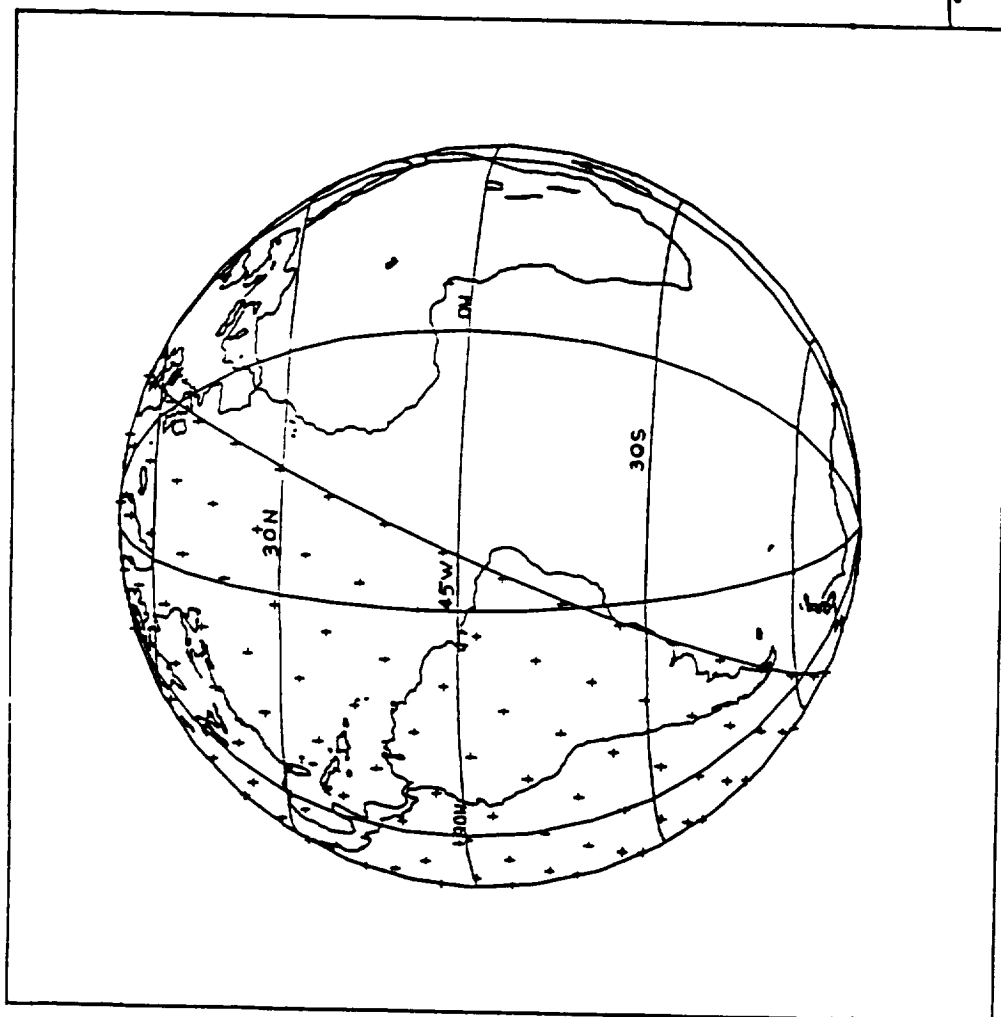
ACTIVITY:tran

DESCRIP:ANDES MCSAIC

EARTH 2: C/A +2 DAYS

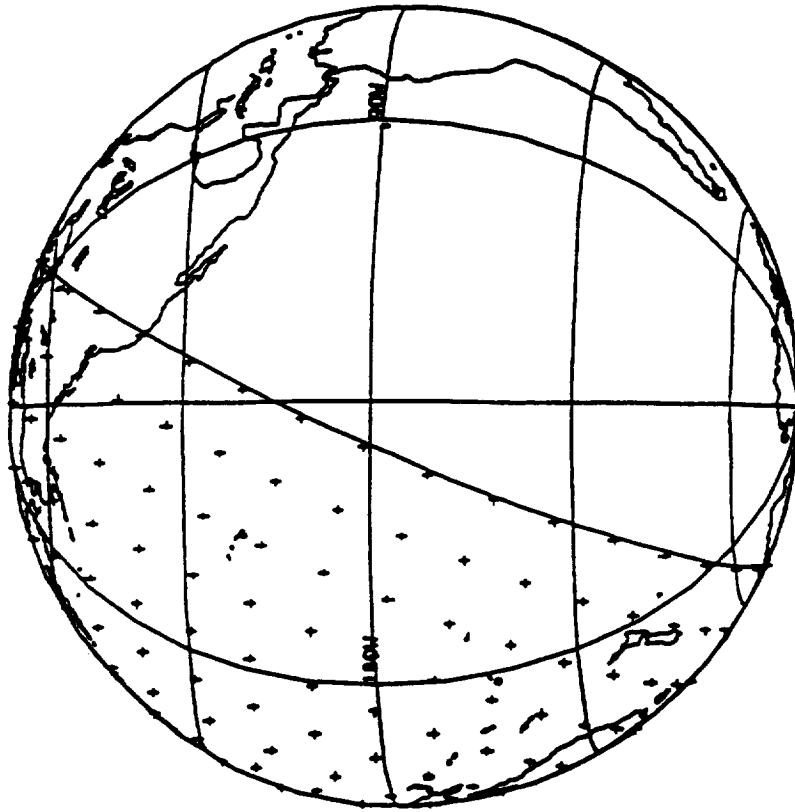


EARTH 2: C/A +2 DAYS, 17 HOURS

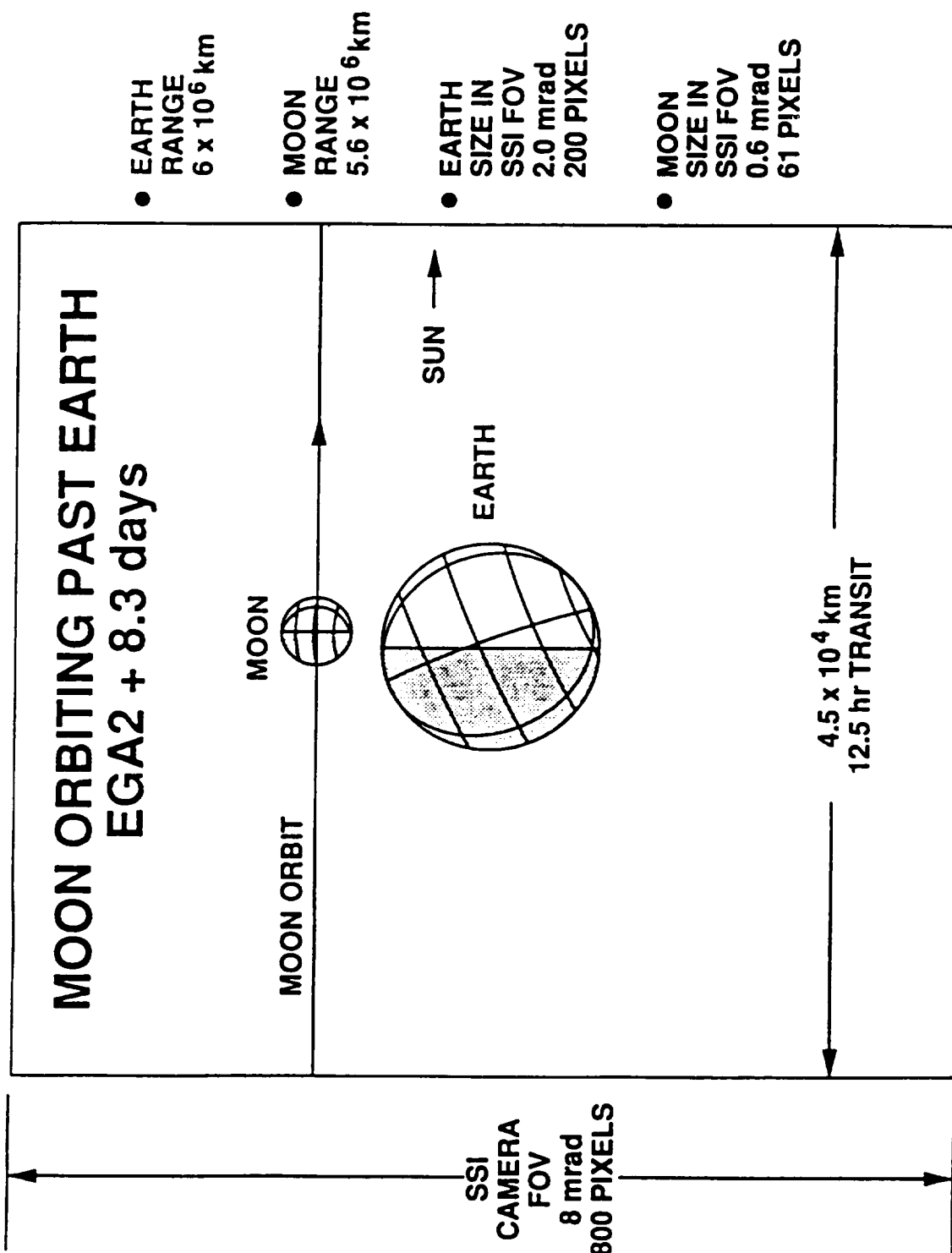


2—SSI FOV

EARTH 2: C/A +3 DAYS



SSI
FOV



C. Network Information/User Services Plenary

Internet Information **Servers**

**NASA Science Internet
Users Working Group
Conference**

30 March – 3 April 1992

**Joyce K. Reynolds
Information Sciences Institute
University of Southern California
Marina del Rey, California
USA**

Overview

Information Servers/ Directory Services

RFCs & FYIs

Notable NICs

Mail Servers

Information Servers/

Directory Services

– De-centralized

– Independent

– Numerous

Information Servers/

Directory Services

- Archie
- Gopher
- Knowbot
- Netfind
- Prospero
- Whois
- Wide Area Information Server (WAIS)
- World Wide Web (WWW)
- X.500/White Pages

Archie

Archie provides public access files, documents, papers, programs

No “archie” protocol per se

Archie has adopted the Prospero protocol for its use

Plans to make information available through WAIS and WWW

Developers:

**Peter Deutsch & Alan Emtage
McGill University**

Archie

System is utilized by retrieving file listings of predetermined anonymous FTP archive sites

Information is processed and entered into a dedicated database system

User may then query this database via:

**Telnet
Email
or Prospero-based
archie client interfaces**

Archie

Currently the most used Internet Information Service

Estimated that several servers worldwide provide answers to over 30,000 queries per day

Gopher and Prospero already have gateways toarchie

Tests have been carried out with WAIS & WWW

Archie

Future Plans Include:

Expansion of range of information to allow users to search for specific kinds of software packages

Determine location of anonymous FTP sites

Local mailing lists of interest

Archie

Discussion groups:

archie-people@cc.mcgill.ca

Documentation from:

archie.mcgill.ca: /archie/doc

Client source from:

archie.mcgill.ca: /archie/clients

(DOS, VMS, Unix Telnet, X11, NeXTStep)

Gopher

Is a distributed information system

Public access files, documents, papers, programs

Based on TCP/IP for sending servers to clients

Gopher is developed at the University of Minnesota

Gopher

Gopher uses its own protocol for transferring information

It is also designed to act as a gateway to other Internet Information Servers

Gopher

**Client implementations
exist for:**

**UNIX
MS-DOS
Macintosh**

**Server implementations
exists for:**

**UNIX
Machintosh
NeXt**

**Software available:
boombox.micro.umn.edu**

Gopher

Source from:

**boombox.micro.umn.edu:
/pub/gopher/***

Documentation:

**boombox.micro.umn.edu:
/pub/gopher/gopher_protocol/***

Knowbot Program **(KNOWledge roBOT)**

An active, intelligent program

Currently specialized for accessing information in the National Library of Medicine Medical Subject Heading (MeSH)

Acts on behalf of the user to carry out search & retrieval tasks.

Exchanges messages with other Knowbot programs

Moves from one system to another to carry out the user's requests

Developed by CNRI

Netfind

Internet White Pages tool

Information about people

Uses a database of hints and existing services (finger, SMTP, DNS) to search for information

**Developed by Mike Schwartz
University of Colorado, Boulder**

Prospero

A distributed file system based on the Virtual System Model

Information is public access files, documents, papers, programs

Provides tools to help users organize Internet resources

Users may construct customized views of resources

Accomplished by creating links to remote and local files in directories

Prospero

Remote files may be available in various forms (FTP, NFS, etc.)

Files appear to the user to be in a local file system

The actual host and access to the file can be invisible to the user

Developed by Clifford Neuman of USC/ISI

Prospero

**Combines with Information
Providers such as WAIS and
archie**

**Able to handle hypertext links of
WWW**

**Plans underway to have Prospero
and WAIS gatewayed**

**WWW is expected to be added in
the future**

Prospero

Discussion groups are:

info-prospero@cs.washington.edu

Source available from:

**june.cs.washington.edu:
pub/pfs/src**

Documentation from:

**june.cs.washington.edu:
pub/pfs/doc/***

WHOIS

Oldest service

Simple access protocol

Information about people

One central database

NIC.DDN.MIL

Example:

%whois reynolds, joyce
Connecting to id Database.....
Connected to id Database
Reynolds, Joyce K. (JKR1)
JKREY@ISI.EDU
University of Southern California
Information Sciences Institute
4676 Admiralty Way
Marina del Rey, CA 90292
(213) 822-1511

**Record last updated on
07-Jan-91.**

Wide Area Information Server (WAIS)

**Allows for indexing, searching, and
retrieval of documents across the
Internet**

Based on ANSI Z39.50

**Spearheaded by a group at Thinking
Machines, Inc.**

Project headed up by Brewster Khale

Wide Area Information Server (WAIS)

Basic architecture

**WAIS servers running on a
number of hosts in the Internet**

**Directory of Servers (DOS) server
at top**

DOS lists WAIS “sources”

**User get to choose certain sources
to which their question will be
directed**

Wide Area Information

Server (WAIS)

Current implementation

Focuses on large text databases for which one subcomponent of the system created full-text indices

It is these indices which are queried

Server(s) return a set of document IDs to the client

Users can then choose certain documents for retrieval and use

WAIS

For more information:

- * `wais-discussion@think.com`**
weekly digest of mail from users and developers on Electronic Publishing
- * `wais-talk@think.com`**
interactive list of developers
- * `alt.wais`**
a netnews discussion group on WAIS issues
- * `WAIS Unix Release`**
Freeware releases of client code protocol code server code

World Wide Web

(WWW)

An Internet-based hypertext system

Provides user with “links” that can be constructed from words or phrases in a WWW document to other documents

WWW is being run from CERN

Project headed up by Tim Berners-Lee

World Wide Web

(WWW)

WWW uses its own protocol to transfer information

Provides a very powerful mechanism for locating and retrieving information

World Wide Web

(WWW)

Plans are underway to have a WWW gateway to WAIS,archie, and possibly Gopher

World Wide Web (WWW)

The discussion groups are:
chi-arch@uccvms.bitnet

(LISTSRV)

www-talk@nxoc01.cern.ch

Source available from:
info.cern.ch: /pub/WWW/src

(NeXTStep, Unix command line)

Documentation is available from:
info.cern.ch: /pub/WWW/doc

X.500/White Pages

Peter Yee/ARC

Internet Documentation for USERS

(not WIZARDS!):

FYI RFCs

FYI 12: "Building a Network Information Services Infrastructure"

FYI 11: "A Catalog of Available X.500 Implementations", Jan. 1992.

FYI 10: "There's Gold in them thar Networks! or Searching for Treasure in all the Wrong Places", Dec. 1991.

FYI 9: "Who's Who in the Internet: Biographies of IAB, IESG and IRSG Members", Aug. 1991.

FYI 8: "Site Security Handbook", Jul. 1991.

FYI 7: "FYI on Questions and Answers: Answers to Commonly Asked "Experienced Internet User" Questions", Feb. 1991.

FYI 6: "FYI on the X Window System", Jan. 1991.

FYI 5: "Choosing a Name for Your Computer", Aug. 1990.

FYI RFCs (cont.)

FYI 4: "FYI on Questions and Answers: Answers to Commonly asked "New Internet User" Questions", Feb. 1991."

FYI 3: "FYI on Where to Start: A Bibliography of Networking Information", Aug. 1990.

FYI 2: "FYI on a Network Management Tool Catalog: Tools for Monitoring and Debugging TCP/IP Internets and Interconnected Devices", Apr. 1990.

FYI 1: "F.Y.I. on F.Y.I.: Introduction the F.Y.I. Notes", March 1990.

Internet Documentation

Process

1) Final documents are RFCs.

Available on-line in libraries
around the world.

2) IETF Working groups develop
drafts.

IESG reviews the drafts,
makes recommendations.

IAB approves the drafts
for RFC publication.

Request for Comments

Document Series

– Started in 1969

– Now have 1304

– Since RFC 500, all are
available on-line

– Distribution is primarily
via the network (FTP & EMail)

RFCs & FYIs

Primary Repositories:

NIC.DDN.MIL,
FTP.NISC.SRI.COM,
NIS.NSF.NET, NISC.JVNC.NET,
VENERA.ISI.EDU,
WUARCHIVE.WUSTL.EDU,
SRC.DOC.IC.AC.UK
FTP.CONCERT.NET

Secondary Repositories:

Sweden, Germany, France,
Netherlands, Finland, Norway,
Denmark, Australia, Pacific Rim
and the United States

The RFC Info Service

An email based service

**Helps in the locating
and retrieval of RFCs
and FYIs**

For example:

**To: rfc-info@ISI.EDU
Subject: getting rfc**

help: ways_to_get_rfcs

Notable NICs

DDN (NIC)

Merit

NSF (NNSC)

SRI (NISC)

Defense Data Network (DDN) Network Information Center

Assists DDN users in obtaining information about the DDN and the Internet.

Assigns IP network numbers, autonomous system numbers, and administers Domains

The DDN NIC is reachable at:
(800) 365-3642, and via electronic mail to: "nic@nic.ddn.mil"

Merit/NSFNET **Information Services**

Services include:

**Merit Networking Seminars
NSFNET publications
online information services
consulting**

**Merit/NSFNET is reachable at:
(313) 936-3000 and via
electronic mail to:
"nsfnet-info@merit.edu"**

NSF Network Service **Center**

**Provides information services
to the NSFNET end-user community**

**Including:
online information
workshops
resource cataloging
technical support.**

**The NNSC is reachable at:
(617) 873-3400, and via
electronic mail to:
"nnsc@nnsc.nsf.net"**

SRI Network Information **Systems Center**

**Provides network tools and
information services to
the Internet community.**

**Including:
online information
FTP repository of RFCs
Only service offering
hardcopy RFCs**

The SRI NISC is reachable at:

**(415) 859-6387
(415) 859-3695
(415) 859-6028 (FAX)
and via electronic mail
to: nisc@sri.com**

Mail Servers

RFC-Info

FAST

MOSIS

FAST

Electronic broker service for purchasing:

**electronic components test equipment
optical parts & equipment
communications equipment
laboratory equipment and supplies**

Via EMail

Contact:

To: FAST@ISI.EDU

In the body of the message:

Request: Information

Topic: Introduction

Request: End

MOSIS

Broker service for obtaining custom VLSI chips. Used by university researchers and students learning about VLSI, as well as professionals designing new chips

Contact:

To: MOSIS@MOSIS.EDU

In the body of the message:

Request: Information

Topic: Topics, Library

Request: End

Telnet

GORD

(NIST GOSIP Register Database)

**telnet to:
129.6.48.100**

**user-name:
gosip.db**

Telnet

STIS

**(NSF Science and Technology
Information Service)**

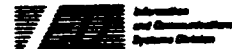
**telnet to:
128.15.0.195.40
stis.nsf.gov**

X.500 Directory Services in NASA

**Peter Yee
Ames Research Center**

April 1, 1992

Peter Yee, Network Services Development Group M/S: 233-18



Directory Services in NASA

- What's an X.500?
- X.500 throughout the world
- X.500 in NASA
- Issues
- Status and Recommendations

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What's an X.500?

- Service description
- How it works
- Directory Service Standards Bodies
- Directory Service Standards
- Implementations
- Directory Service Pilots

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Directory Service Standards Bodies

- CCITT/ISO are joint issuers of X.500.
- NIST - mandating use of X.500 in GOSIP Version 3.
- OIW - designing profiles for real world use of the directory.
- NADF - working on making X.500 a commercial reality.
- IETF - targeting directories on the Internet and solving operational issues.

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X.500 Service Description

X.500 is a:

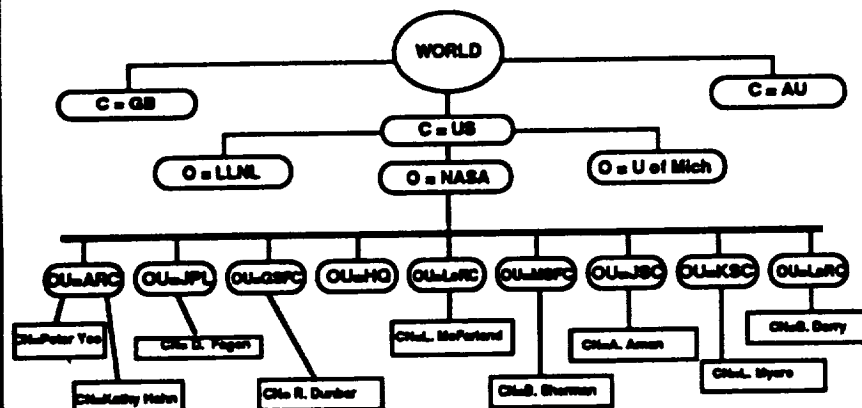
- Distributed database.
- Name service.
- White pages system.
- The solution to all of OSI's problems.

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Information
and Communications
Systems Division

Directory Information Tree

- A (suggested) hierarchical scheme for data organization.
- Has levels for countries, organizations, people, etc.
- Scalable for global usage.



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Information
and Communications
Systems Division

How it works

- X.500 Model
- User's Perception
- Application of X.500

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X.500 Model

X.500 service is made of two parts:

- DUA (Directory User Agent - a client)
- DSA (Directory System Agent - a server)

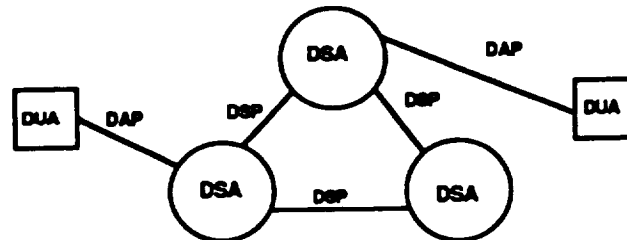
and it uses two protocols:

- DAP (Directory Access Protocol)
- DSP (Directory System Protocol)

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X.500 Model



DSA Directory System Agent
DUA Directory User Agent
DAP Directory Access Protocol
DSP Directory System Protocol

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User's Perception

- Consistent interface to data from all sources.
- X.500 model not apparent to user.
- May be accessed through directory browsers or other applications which incorporate DUAs.

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Information
and Communications
Systems Division

Applications of X.500

- X.400 Electronic Mail
- White Pages
- Resource Locations
- Naming Services

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X.400 Electronic Mail (1988) Reliance on the Directory

- Naming and Addressing
- Distribution List Expansion
- Authentication and Security
- Capability assessment (i.e. supported recipient options.)
- Routing and path optimization.

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Applications of X.500

White Pages

- A large telephone book
- Inexact matching
- Searching

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Applications of X.500

Resource Location and Naming Services

- Locate computers, peripherals, and services.
- Translate human understandable names into machine identifiers (like the Internet DNS).

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Implementations

Commercial:

- Retix, OSIWare, Unisys, and even Novell

Non-Commercial:

- QUIPU, Custos, Pizarro

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QUIPU

- Major directory research platform capable of running on many UNIX systems.
- Basis for some commercial products.
- Widely used and well-tested.
- Directory Service Agent (DSA)
- Supports 1988 Standards
- Low initial cost
- Requires ISODE

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Why QUIPU?

- Supports distributed directory information architecture.
- Includes replication and access controls.
- Integrates with PP X.400 electronic mail for distribution list expansion.
- Provides an important service with no current competition.
- The price is right!

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QUIPU

Future of QUIPU:

- ISODE Consortium
 - Non-profit organization to foster the growth of the ISODE.
 - Responsible for future development.
 - NASA is a charter member.

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Directory Service Standards

- CCITT/ISO X.500 - X.521 series of recommendations
- NIST - GOSIP Version 3
- OIW - OIW Profiles
- NADF - NADF 175, etc.
- IETF - numerous RPCs

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Directory Service Pilots

- FOX
- PSI WPP
- PARADISE
- NIST/GSA
- Internet Pilot
- NASA Pilot

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Fielding Operational X.500 (FOX)

- Jointly funded by DARPA, NSF, DOE and NASA.
- Testing interoperability of QUIPU and NIST's Custos implementation of X.500.
- Merit developed object identifiers to store the Internet network infrastructure information in X.500.
- SRI developed an X.500 version of the WHOIS database.
- PSI has created an index into the RFC/FYI document series and applications to locate and retrieve RFCs with X.500.

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Performance Systems International (PSI) White Pages Pilot (WPP)

- Manages the US Directory Information Tree of the X.500 world pilot.
- 73 organizations
- Uses the QUIPU implementation of X.500.
- 300,000 entries

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Piloting A Researcher's Directory Service In Europe (PARADISE)

- Actually manages the global directory pilot.
- 23 countries
- 420 organizations
- 500,000 entries
- Uses the QUIPU implementation of X.500.

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NIST/GSA

- Currently serves NIST, GSA, and NSF.
- Uses Custos, NIST's implementation of X.500.

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Internet Pilot

- Encompasses the PSI WPP and Paradise, plus several other countries.
- A major source of directory research and experience.
- Testbed for Internet RFCs and experimentation.

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NASA Pilot

- Servers running at ARC, GSFC, JPL, LeRC, and MSFC.
- Proxy service provided for DFRF, JSC, KSC, and LaRC.
- Hope to have HQ join the pilot and move proxy servers to respective centers.
- Approximately 50,000 entries available.

Peter Yu, Network Services Development Group M/S: 233-18

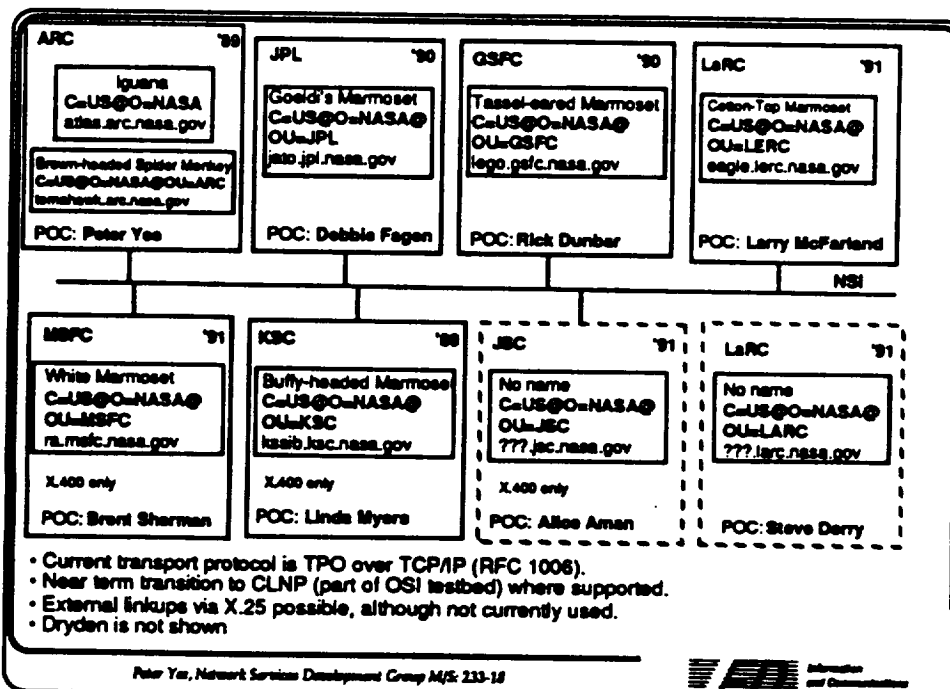


X.500 in NASA

Directory Service Accomplishments

- Establish NASA White Pages Pilot under PSI WPP.
- Relational database front-end for QUIPU.
- Search for directory user agent.
- Actively participate in development of X.500 software and related support infrastructure.

Peter Yee, Network Services Development Group M/S: 233-18



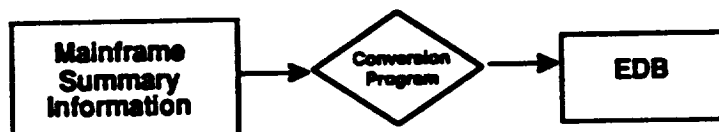
How to populate QUIPU Entry Data Block (EDB)?

- Civil Servant information is from NASA Personnel and Payroll System (NPPS).
- Contractor information is from other applications on the same IBM Mainframe.
- Additional information is not centralized (i.e. electronic mail address).

Peter Yee, Network Services Development Group M/S: 233-18



Existing Method for Creation of Directory Entries

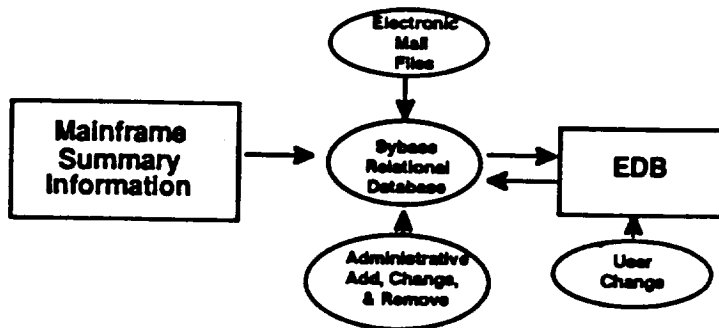


- Additional information cannot be stored on mainframe.
- Additional information would not be stored in EDB because they would be lost after each EDB creation.

Peter Yee, Network Services Development Group M/S: 233-18



New Method for creation of Directory Entries



- Relational Database becomes centralized master for additional directory information.
- Relational database can be modified to accept other data feeds.

Peter Yee, Network Services Development Group M/S: 233-18



X.500 Development

- Beta tester for QUIPU and ISODE software.
- Created Macintosh DUA called MacDish.
- Working in IETF, IEEE, and ANSI on X.500 standards, profiles, and additions.

Peter Yee, Network Services Development Group M/S: 233-18



Directory User Agents

Terminal

- Dish - Provides a very powerful interface into the Directory and gives a user full access to the Directory Access Protocol (DAP).
 - Can be used to build custom interfaces, which are easier and more intuitive.
- Fred - A DUA optimized for White Pages queries.
 - Can make complex searches, and compose mail addresses using the MH mail.
- SD - Screen Directory
 - Screen oriented interface with the same functionality as POD.
- DE - Directory Enquires

Peter Yu, Network Services Development Group M/S: 233-18



Directory User Agents

X-Windows

- Xwp - X white pages. X-Windows interface.
 - Supports user-friendly naming.
- Pod - X windows. Intended for naive users.
 - Click on buttons to pop up windows with more Directory Information.
- XDI - Advanced version of POD from Bellcore.
- XT-DUA - Commercial DUA from X-Tel. Motif-based user interface.

Peter Yu, Network Services Development Group M/S: 233-18



Directory User Agents

Macintosh and IBM PC

- MacDish - NASA/Ames Research Center
- maX.500 - University of Michigan (RFC 1249)
- PSIWP - Performance Systems International, Mac (RFC 1202)
- PCWP - Performance Systems International, PC (RFC 1202)

Peter Yee, Network Services Development Group M/S: 233-18



DISH

```
atlay.dic: nava qou
Dish -> 1
1 organizationalUnitName=Ames Research Center
2 organizationalUnitName=Bryden Flight Research Facility
3 organizationalUnitName=Earth Observing System
4 organizationalUnitName=Goddard Institute for Space Studies
5 organizationalUnitName=Goddard Space Flight Center
6 organizationalUnitName=Headquarters
7 organizationalUnitName=Jet Propulsion Laboratory
8 organizationalUnitName=Johnson Space Center
9 organizationalUnitName=Kennedy Space Center
10 organizationalUnitName=Langle Research Center
11 organizationalUnitName=Lewis Research Center
12 organizationalUnitName=Marshall Space Flight Center
13 organizationalUnitName=Michoud Assembly Facility
14 organizationalUnitName=Stidell Computer Complex
15 organizationalUnitName=Space Station Freedom Project Office
16 organizationalUnitName=Sterennis Space Center
17 organizationalUnitName=Wallops Flight Facility
18 organizationalUnitName=White Sands Test Facility
19 commonName=Atlas
20 commonName=Brown-headed Spider Monkey
(Limit problem)
Dish -> nov 1
Dish -> search -filter cm="Peter Yee"
```

Peter Yee, Network Services Development Group M/S: 233-18



DISH

```

Dish -> sh 21
objectClass          - pilotPerson
commonName           - Peter Yee
commonName           - Peter Edward Yee
commonName           - Peter E. Yee
surname              - Yee
localityName         - Moffett Field, California
stateOrProvinceName  - California
title                - Electronics Engineer
description           - NASA Ames Research Center Computer Network Security Resp
oncs Team Leader
postalAddress         - NASA Ames Research Center
                    - MS 233-18
                    - Moffett Field, CA 94035
postalCode            - 94035-1000
physicalDeliveryOfficeName - Moffett Field
telephoneNumber       - +1 415-604-3812
userid               - yee
textEncodedAddress    - cn=yee,edu@nslmail.prd-nrc.org,nasa,curedh,grmpeter,an
myo,1ms
rf0822mailbox        - yee@nasa.arc.nasa.gov
favouriteDrink        - Chocolate Milkshake
roomNumber            - K233/240
photo                - 

```

Peter Yee, Network Services Development Group M/S: 233-18

Information
and Communications
Systems Division

MacDish

MacDISH

Move Up
Move Down
List
Search
Help

Search: By Last Name
☒ Search For:
☐ Move To:

☒ Approximate Match
☐ Exact Match

Directory: The World
Location: US, National Aeronautics and Space Administration

organizationalUnitName-Bryden Research Center
organizationalUnitName-Bryden Flight Research Facility
organizationalUnitName-Earth Observing System
organizationalUnitName-Goddard Institute for Space Studies
organizationalUnitName-Goddard Space Flight Center

Peter Yee, Network Services Development Group M/S: 233-18

Information
and Communications
Systems Division

MacDish

	Detail
Entity Name:	cn=Peter Yee
Telephone:	+1 415-604-2812
Address:	NASA Ames Research Center MS 233-18 Moffett Field, CA 94035
rfc822Mailbox:	yee@ames.arc.nasa.gov
OtherMailbox:	No Entry
PagerNumber:	+1 415-607-1821

Peter Yee, Network Services Development Group M/S: 233-18



Other DUA's/Directory Users

- DS Agent/Quickmail Integration
- Internet whois server
- XUA
- PP

Peter Yee, Network Services Development Group M/S: 233-18



Directory Service Issues

- Standard is still evolving (X.500 1992)
- PC/MAC User Agents
- Vendor support and commitment
- User demand

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Current Status

- ICCN/S recommends an engineering operations test period at (at least) 3 sites (Ames and two sites TBD).
- Continue to search for more DUA's.
- NAS purchased a machine to serve as Ames DSA.

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Recommendations

- Determine level of support needed at each Center for a fully operational DSA, based on experiences from engineering operations test.
- Coordinate with personnel and payroll groups at each Center to obtain data for Center's DSA.
- Provide a mechanism for retrieving directory information via electronic mail.
- Work within ISODE Consortium to have QUIPU tested for X.500/GOSIP compliance.

D. Network Communications Technology Plenary

**NASA SCIENCE INTERNET
USERS WORKING GROUP
CONFERENCE**

APRIL 2, 1992

"INTERNET FORECAST"

Vint Cerf

**Corporation for
National Research Initiatives**

OVERVIEW

➡ **Scaling**

➡ **Speed**

➡ **Services**

➡ **Constituents**

➡ **Applications**

➡ **Service Providers**

➡ **Government Roles**

THE SCALING CHALLENGE

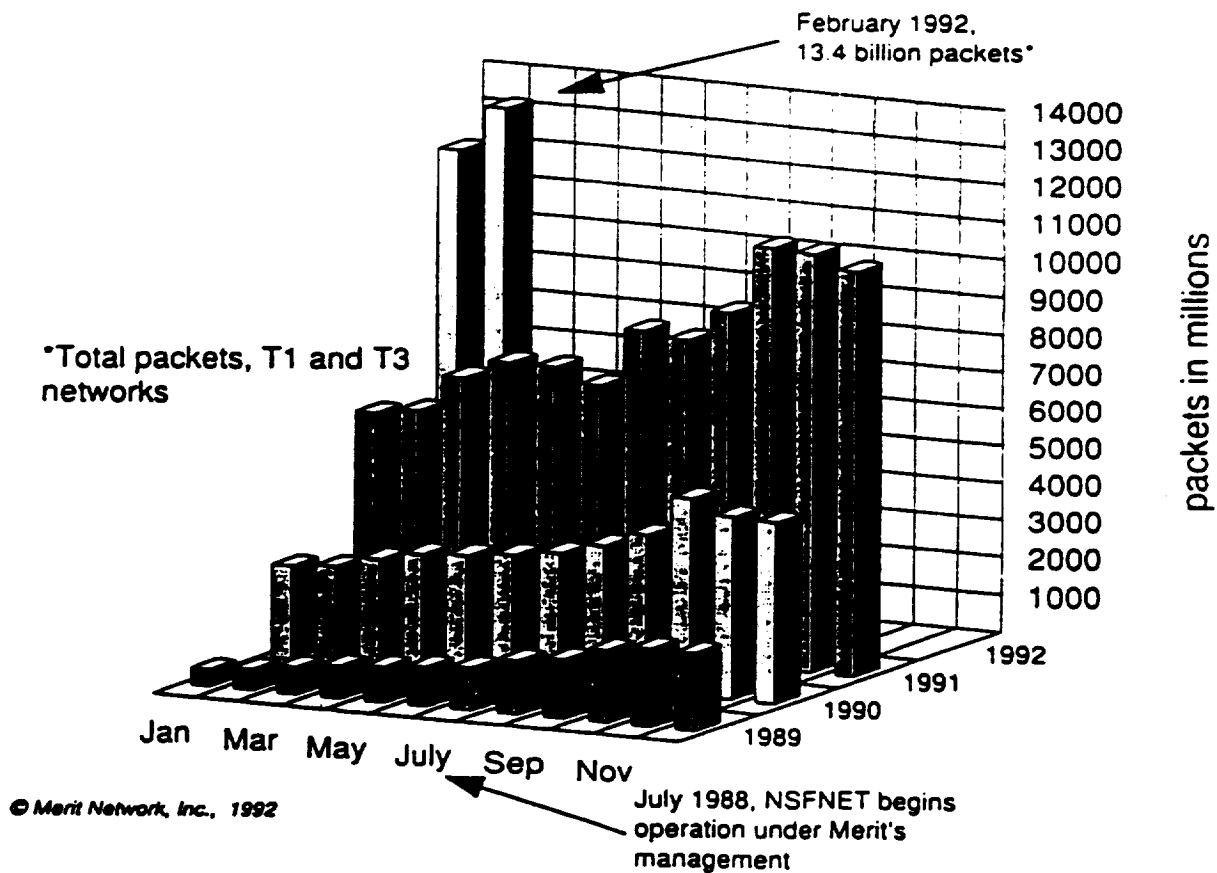
- ☺ **Internet doubles every 7-12 months**
- ☹ **Running out of routing power**
- ☹ **Running out of Address Space**

- ☺ **We need to support a BILLION networks**
- ☹ **(see above)**
- ♥ **Must deploy incrementally**
- 🕒 **Must deploy IN TIME!**

MORE SCALING CHALLENGES

!! We need more capacity

NSFNET Packet Traffic History



ROAD WARRIORS

☞ **Co-Chairs: Phill Gross/ANS
Peter Ford/LANL**

✓ **IAB Charter
(Architecture Retreats)**

🕒 **Their 4 month mission:**

**To boldly go where no routing
and addressing architecture has
ever gone before!**

✓ **March 92 IETF Report**

✓ **Various Working Group Spinoffs**

ROUTING

THE ISSUE

- IS-IS for CLNP
OSPF for IP
Dual IS-IS/Proto.
- Border Gateway Protocol 4
(Masking/CIDR)
- Internet Domain Routing
Protocol (IDRP) for IP/CIDR
- Address Assignment Issues
- Internet Domain Policy
Routing (IDPR)

Route Servers
Policy Routing
TOS/QOS Routing

SERVICES

■ **Network Services**

Frame Relay (56, DS1, DS3?)

**SMDS/DQDB (56, DS1, DS3,
OC3, OC12...?)**

**ATM (DS3, OC3, OC12, OC24,
OC48,...)**

PLAnet (IBM)

All Optical (1G, 10G, 20G, 1T,...)

■ **Transmission Services**

**HiPPI/SONET (OC3, OC12,...)
[800M, 1600M]**

All Optical?

SERVICES (2)

- **Real-Time Voice/Video**
- **QOS Resource Management**
- **Mobility Support**

**Mobile Hosts (LAN Reconnect,
Cellular/PCN, Satellite)**

Mobile Nets (cars, planes)

- **Ubiquitous Computing
(tabs, boards, pads)**

CONSTITUENTS

- **CS/EE » R&D » Universities »
Military » Government »
Industry » K-12/Libraries »
Residential**

[Home Lans are HERE!]

- **US/North America » EUROPE »
Pacific Rim » East. Europe »
Latin America » Mideast » CIS
» Africa**

APPLICATIONS

- **Telnet, X-Windows, V-Reality**
- **EMAIL, Comm'l EMAIL, PEM, Info Services, EDI, Electronic Commerce**
- **FTP, Anonymous FTP, archie, gopher, Knowbot Programs, WAIS, digital libraries, electronic publishing**
- **Talk, Internet Relay Chat, shared windows/blackboard, video-conferencing, collaboration technologies**
- **Distributed Laboratories, Telepresence**

 **BANDWIDTH HOGS Nightmare!**

SERVICE PROVIDERS

- **Government Private Nets**
(NSINET, DARTNET, ESNET, NSFNET, MILNET,...)
- **Special Value-Added Nets**
(ANSNET, ALTERNET, PSINET, SURANET, CERFNET, JVNCCNET, LOS NETTOS, BARRNET, SESQUINET, PREPNET, NEARNET, EBONE, NORDUNET, DFN, WIDE, AARNET,...)
- **Public Carrier Nets**
(RBOC Frame Relay/SMDS Svc, IXC FR/SMDS, INFONET, SWIPNET, UK PIPEX, SPRINTLINK, ...)

FLASH!

Amendment to HR2936

Science Subcommittee (Boucher, VA):

Sec 3 of NSF Act of 1950 amended:

(g) ...the Foundation is authorized to foster and support the development and use of computer networks which may be used substantially for purposes in addition to research and education in the sciences and engineering, if the additional uses will tend to increase the overall capabilities of the networks to support such research and education activities.

[Full S&T Committee Markup 4/2/92]

NASA & NREN

Tony Villasenor
Program Manager, NASA Science Internet
Milo Medin
Deputy Project Manager, NASA Science Internet

OFFICE OF SPACE SCIENCE AND APPLICATIONS



OFFICE OF THE PRESIDENT

Office of Science and Technology Policy

**Federal Coordinating Council on
Science, Engineering, and Technology
FCCSET**

Committee on Physical, Mathematical, and Engineering Sciences

**High Performance Computing, Communications,
and Information Technology Subcommittee**

High Performance Computing & Communications Program

FEDERAL NETWORK COUNCIL

**ENGINEERING
& OPERATIONS
WORKING GROUP**

**POLICY
WORKING
GROUP**

**RESEARCH
WORKING
GROUP**

**SECURITY
WORKING
GROUP**

**EDUCATION
WORKING
GROUP**

President's Program: NREN Perspective

NREN is a national high speed network to provide distributed computing capability to research and educational institutions and to further advanced research on very high speed networks and applications.

NREN is a network for research and education, not general purpose communications.

The NREN builds on NSFNET, ESNET, NSI and other networks supporting research and education. During 1992, the NREN will accelerate the introduction of commercial 45 megabit transmission technologies and services into operational use, including SMDS.

Also: OSTP Press Briefing, January 30, 1992:

The NREN is a high performance technology testbed for research and education, not for commercial use.

President's Program: NREN Activities

- **Assist upgrades of regional & community of interest networks, where appropriate, especially where these upgrades enhance end-to-end reliability**
- **Produce improved user-level tools to enable scientists & educators to take advantage of the NREN's capabilities.**
- **Refine the understanding of requirements for high capability networks: bandwidth, latency, predictability & stability.**
- **Improve the technologies necessary for policy controls, resource allocation, fair sharing, accounting, security, peering, and routing coordination. Integrate commercial services fully and interconnect to other relevant networks.**
- **Provide for a network information service that acts as a primary source of information on access to and use of NREN.**
- **Enhance the current interconnected multi-agency architecture to provide for the interoperability of Federal and non-Federal networks, to the extent appropriate, in a way that allows for the autonomy of each network component.**

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President's Program: NASA & NREN

Goal: to accelerate the development and application of high performance computing technologies to meet NASA science and engineering requirements.

NASA's program will bring together interdisciplinary teams of computer and computational scientists to develop the necessary technologies within two vertically integrated NASA grand challenge projects that are unique to the NASA mission. These technologies include applications algorithms and programs, systems software, peripherals, networking, and the actual high performance computing hardware. NASA will develop a suite of software tools to enhance productivity, including load balancing tools, run time optimizers, monitors, parallelization tools, as well as data management and visualization tools.

NASA will provide high-speed network connections among NASA, industry and academic researchers.

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HPCC Act, Section 101 (2)

- (2) The Program Shall:
- (A) Provide for the establishment of policies for management and access to the NREN;
 - (B) Provide for oversight of the operation and evolution of the NREN;
 - (C) Promote connectivity among computer networks of Federal agencies and departments;
 - (D) Provide for efforts to increase software availability, productivity, capability, portability, and reliability;
 - (E) Provide for improved dissemination of Federal agency data and electronic information;
 - (F) Provide for acceleration of the development of high performance computing systems, subsystems, and associated software.;
 - (G) Provide for the technical support and R&D of high performance computing software & hardware needed to address Grand Challenges;
 - (H) Provide for educating and training additional undergraduate & graduate students in software engineering, computer science, library & information science, and computational science; and
 - (I) Provide for the security requirements, policies, and standards necessary to protect Federal research computer networks and information resources accessible through Federal research computer networks, including research required to establish security standards for high-performance computing systems and networks;

HPCC Act, Section 102. NREN

- (a) NSF, DOD, DOE, DOC, NIST, NASA, etc. shall support the establishment of the NREN, portions of which shall, to the extent technically feasible, be capable of transmitting data at one gigabit per second or greater by 1996. The NREN shall provide for the linkage of research and education institutions, government, and industry in every state.
- (b) Federal agencies shall work with private network service providers, state and local agencies, libraries, educational institutions, etc. to ensure that researchers, educators, and students have access to NREN. NREN is to provide users with appropriate access to high-performance computing systems, electronic information resources, other research facilities, and libraries.

HPCC Act, Section 102. NREN

(c) NREN characteristics. The NREN shall

1. be developed & deployed with the computer, telecommunications, and information industries;
2. be designed, developed, and operated in collaboration with potential users in government, industry, and research & educational institutions;
3. be designed, developed, and operated in a manner which *fosters & maintains competition* and private sector investment in high speed data networking within the telecommunications industry;
4. be designed, developed, and operated in a manner which promotes R&D leading to development of *commercial standards* that will encourage establishment of privately operated high speed commercial networks;
5. be designed and operated to ensure the continued application of laws that provide network and information resources security measures, incl. those that protect copyright and other intellectual property rights, and those that control access to data bases and protect national security;
6. have accounting mechanisms which allow users to be charged for their usage of copyrighted materials available over the NREN, and for their use of NREN where appropriate & feasible;
7. *ensure the interoperability of Federal and non-Federal computer networks*, to the extent appropriate, in a way that allows autonomy for each component network;
8. be developed by *purchasing standard commercial transmission and network services* from vendors whenever feasible, and by contracting for customized services when not feasible, in order to minimize Federal investment in network hardware;
9. support research & development of networking software & hardware;
10. serve as a testbed for further R&D of high capacity and high speed networks

HPCC Act, Section 102. NREN

(e) **Information services.** The Director of OSTP shall assist the President in coordinating the activities of appropriate agencies and departments to promote the development of information services that could be provided over the NREN. These services may include the provision of directories of the users and services on computer networks, data bases of unclassified Federal scientific data, training of users of data bases and networks, access to commercial information services for NREN users, and technology to support computer-based collaboration that allows researchers and educators around the Nation to share information and instrumentation.

(g) The OSTP Director shall report to Congress on:

1. effective mechanisms for providing operating funds for the maintenance and use of the NREN, including user fees, industry support, and continued Federal investment;
2. the future operation and evolution of the NREN
3. how commercial information service providers could be charged for access to NREN, and how NREN users could be charged for such commercial information services;
4. the technological feasibility of allowing commercial information services providers to use the NREN and other federally funded research networks;
5. how to protect the copyrights of material distributed over the NREN; and
6. appropriate policies to ensure the security of resources available on the NREN and to protect the privacy of users of networks.

NREN GOALS

Priority:

- 1) Implement high performance network services and systems to support the networking needs of the HPCC program;
- 2) Enhance and expand, as required, existing regional research and education networks in order to provide appropriate access to HPCC sites and collaborators, and to HPCC networked resources;
- 3) Provide for a smooth and economical transition to the gigabit NREN; and
- 4) Provide for NREN access and use by the broader education (e.g. elementary, secondary, and higher) community and by libraries.

APPROACH

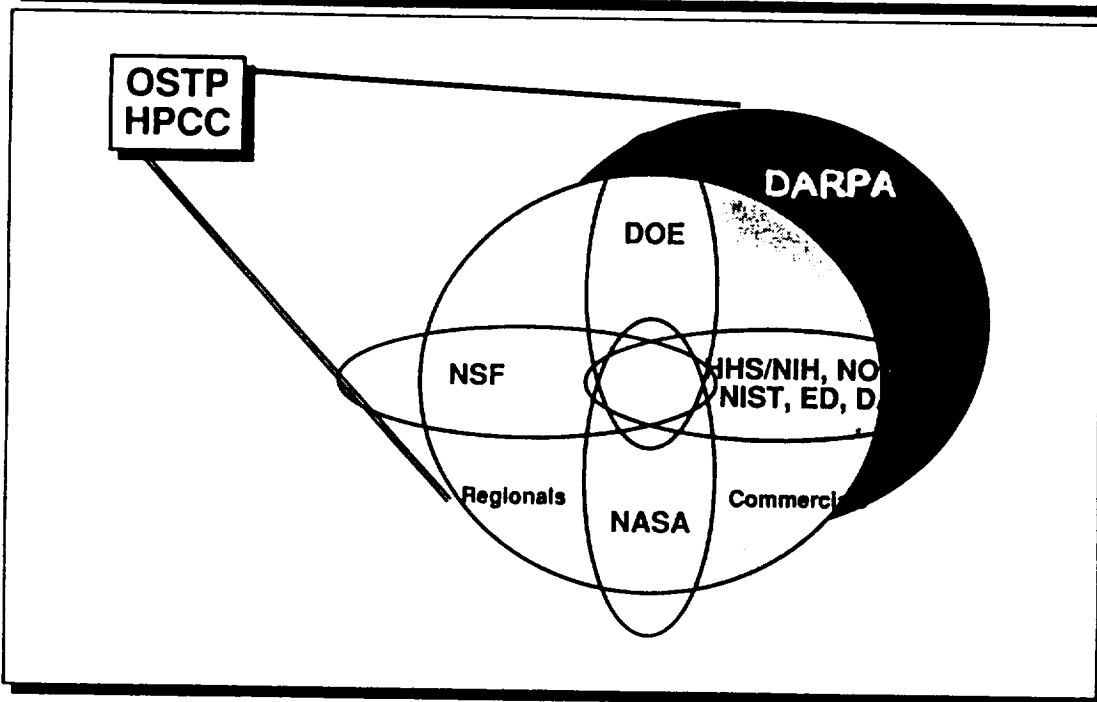


Agency Nets
Regionals
Campus Nets

NSFnet Extension
DARPA R&D
Agency (NSI) Upgrades
Regionals Upgrades
Education Access

Gigabits!

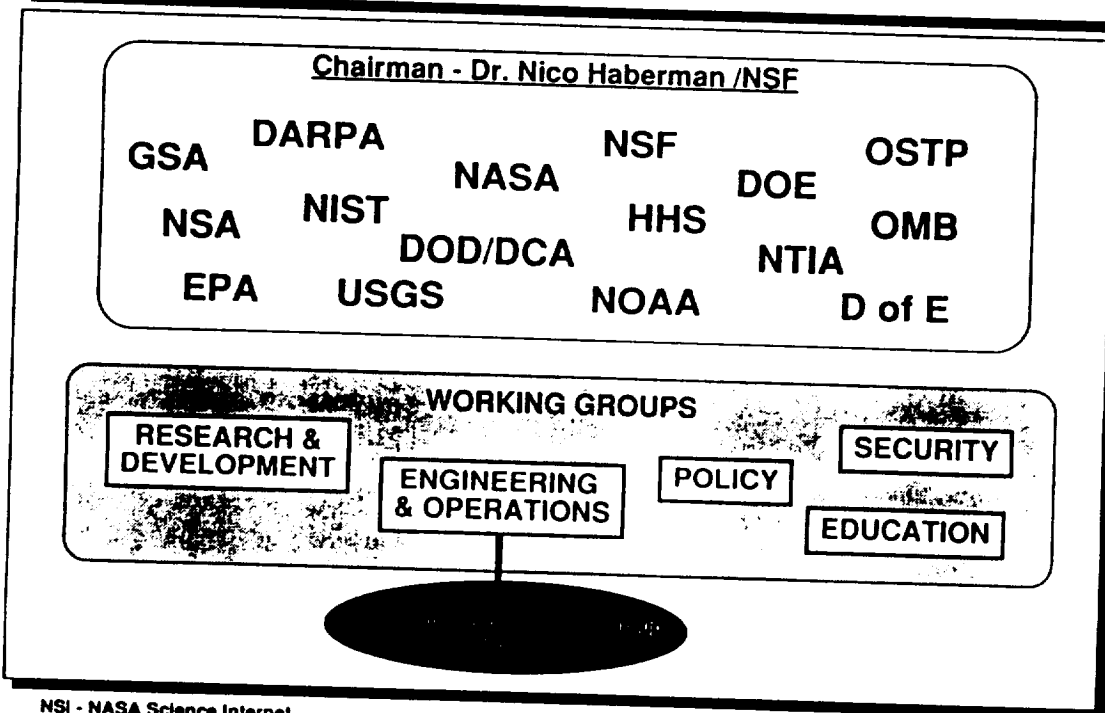
NREN Vision



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FNC Organization



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EOWG Coordination Activities

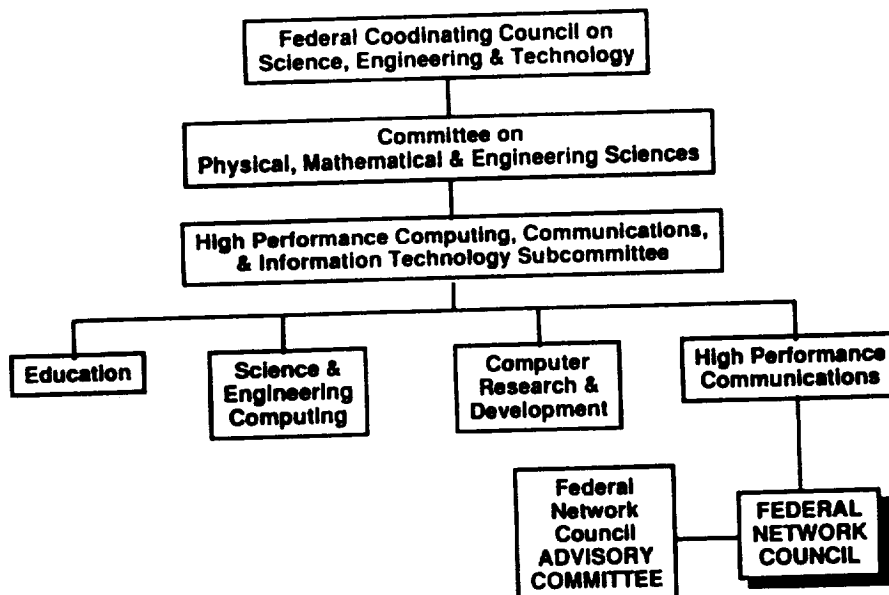
Coordinate plans and activities for the existing federal Internet systems to maintain stability, reliability, and uniform high quality of service:

- Review agency operations and engineering activities to assess their effectiveness
- Arbitrate routing issues for the federal domestic and collaborating international networks that are part of or connect to the Federal Internet
- Maintain working relationships with commercial product & service providers

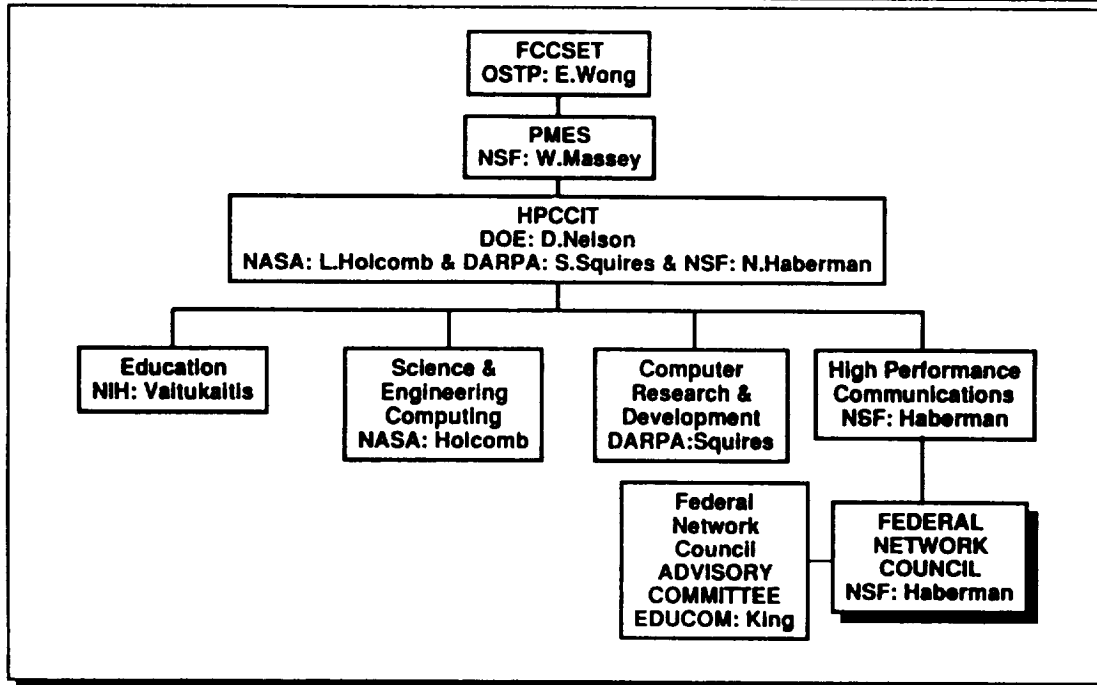
Coordinate the NREN implementations of the HPCC agencies:

- Review & assess NREN architecture options and implications
- Provide recommendations to move from the current Internet to the NREN
- Analyze NREN requirements from HPCC agencies, with due consideration of other agencies as well as the broader research and education community
- Identify policy implications of technical alternatives
- Assist in documenting NREN status to HPCC Management

HPCC Committee Hierarchy



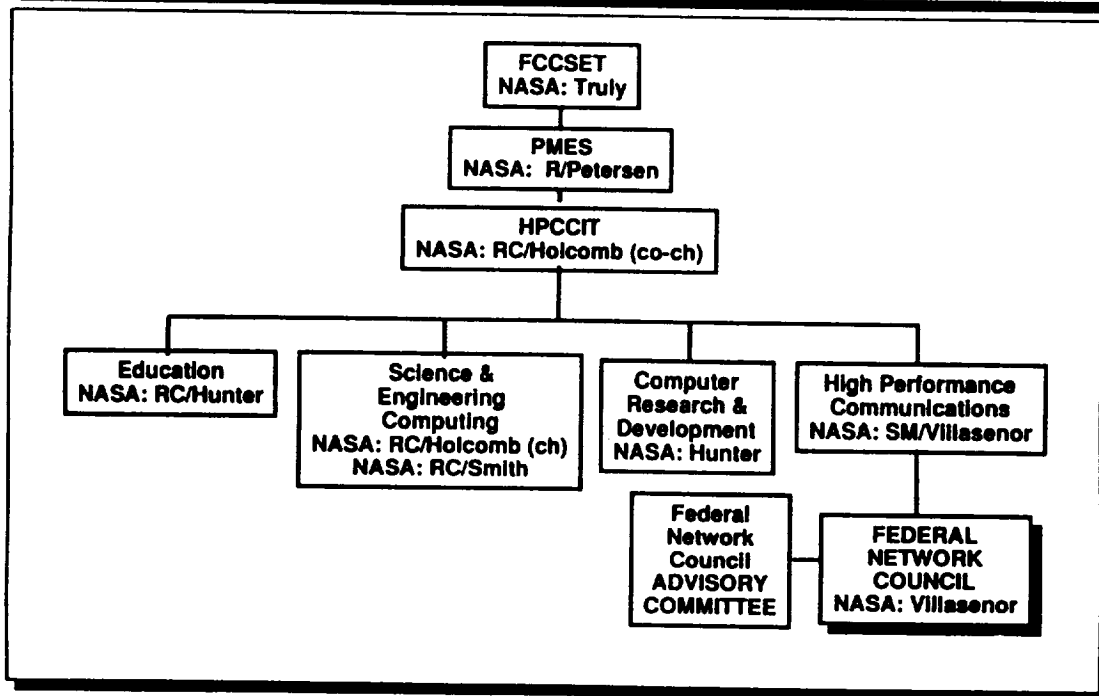
HPCC Committees & Chairs



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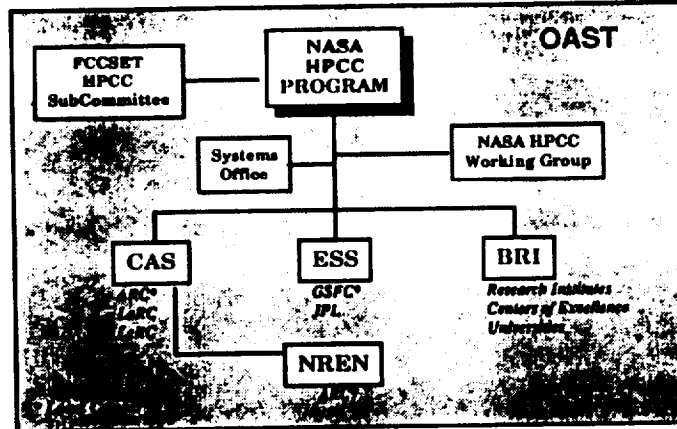
HPCC Committees & NASA Membership



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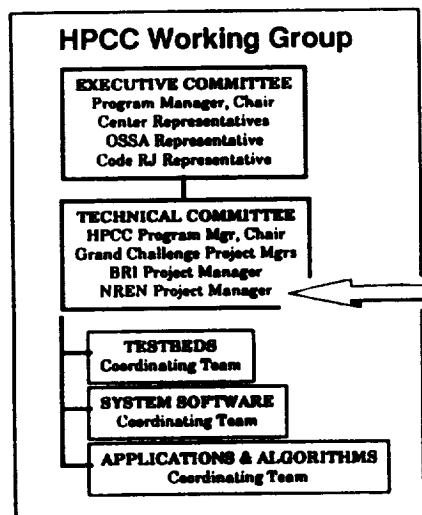
NASA HPCC Program Organization



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NASA HPCC Working Group



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ICCN /S = HPCC

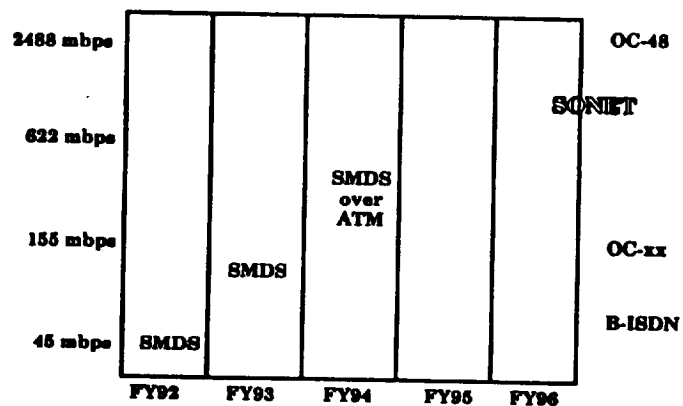
Intercenter Council for Computer Networking - Science

ICCN-S		
<u>CENTER</u>	<u>ORGANIZATION</u>	<u>RESPONSIBILITY</u>
ARC	Code ED	J. Yin
GSFC	Code 520	G. Dorman
JPL	Div. 37	D. Gallop
LARC	ACD	J.Nolan
LERC	MS 1390	D. Cica

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Technology Migration Path



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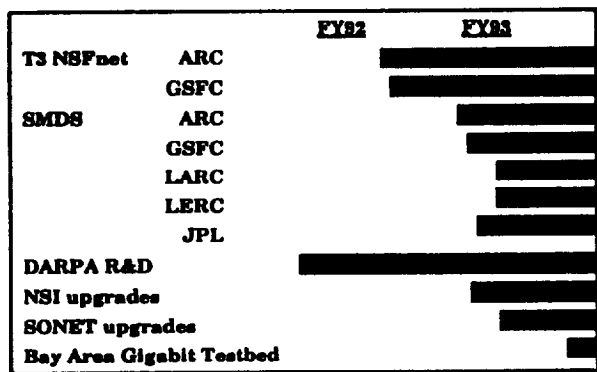
Technology Risks

ACCESS	SERVICE	RATE	SWITCHING	AVAILI
Frame relay	async	DS1 DS3	frame relay cell relay	now 1992
SMDS/SIP	async isoc	DS1/DS3 OC-3	cell relay cell relay	1992 1993
ASTM	async/isoc	DS3 OC-3	ATM ATM	1992 1993
B-ISDN	async/isoc	OC-3:13	ATM	1994

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Initial Implementation Schedule



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NSF: Tempering the Regionals

Regional Infrastructure Enhancements					
	FY92	FY93	FY94	FY95	FY96
MANAGEMENT & OPERATIONS					
Single point of control	▲				
24 x 7 operations staffing		▲			
Inter-NOC backup			▲		
ENGINEERING & TECHNOLOGY					
T1 to campus networks	▲				
T3 to campus networks			▲		
155 mbps access to NREN				▲	
622 mbps access to NREN					▲
USER SERVICES					
NSFNET NIC	▲				
Applications: mail, X.500, etc.		▲			
NREN NIC			▲		
Advanced applications: multi-media					▲

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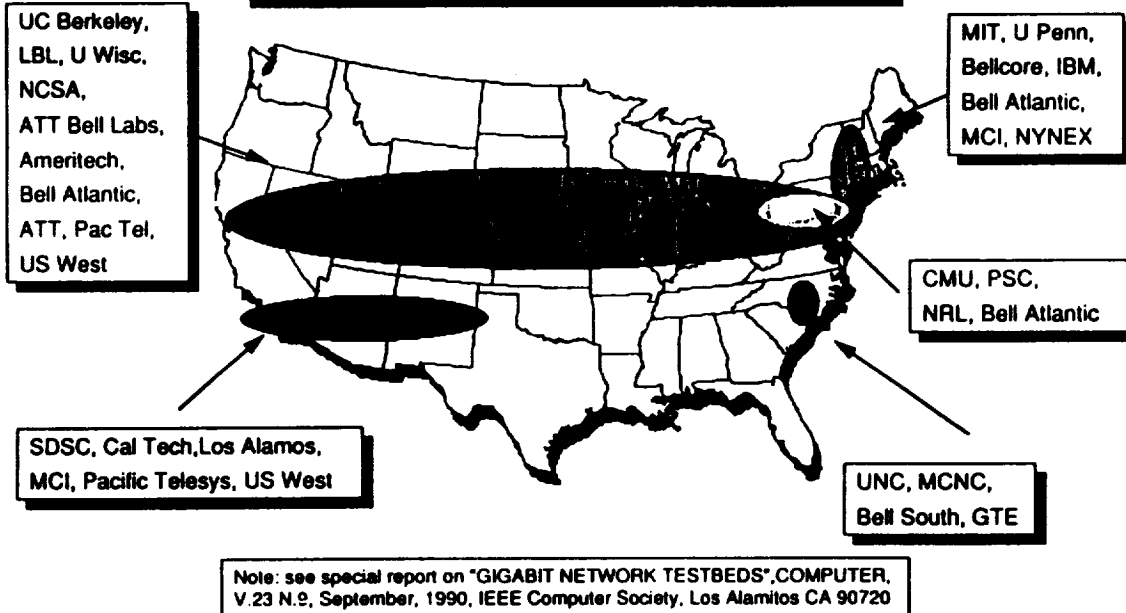
Initial Milestones

	FY92	FY93	FY94
Basic Connectivity to Centers			
T3 NSFNET	▲		
SMDS Pilot		▲	
OC-1 implementation			▲
Higher OC level plans			
INREN Technology & Services			
T3 NSFnet Backbone	▲		
Regional T3 upgrades		▲	
SMDS/ATM backbone			▲
OC-3,12 planning			
Gigabit Technology Deployment			
OC-3 switches & routers		▲	
OC-12 switches & routers			▲
OC-24 switches & routers			

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Industry-University-Government High Speed Network Research Testbeds



NASA PERSPECTIVE

NASA'S NREN

- Funded by HPCC to provide investigator access to/between Grand Challenge facilities
- Represents less than 10% of overall NASA HPCC budget
- Primary role is to support HPCC!

REQUIREMENTS

- T3+ class service between 5 NASA HPCC Centers
- T1+ class service to ~100 Principal Investigators

NATIONAL CONTEXT

- NASA must coordinate NREN with other HPCC agencies
- NASA needs high performance national network infrastructure
- NASA supports U.S. science education and research

NASA Approach

T3 SERVICE BETWEEN NASA CENTERS

- Provided by SMDS switching fabric
- Used wherever high performance access is required
- Provides access to existing NASA networks with HPCC users
- Leverages on TELCO investments & directions

T1 SERVICE TO NASA INVESTIGATORS

- Assumes investigators at sites already connected (i.e., NSFNET)
- No NASA funds for point-to-point T1's
- Use T3 to NSFnet for aggregated T1 requirements
- NSFnet access via FIX's, after upgrade to FDDI

Current Telecommunications Infrastructure

DEDICATED POINT-TO-POINT LEASED LINES

- Local loop provided by Local Exchange Carriers (LEC's)
- Long haul provided by Inter-eXchange Carriers (IXC's)
- No customer switching equipment at TelCo central offices
- Possibility of link failure requires redundancy
- Dedicated to single user use (and billing!)
- Limited bandwidths available (9.6, 56, 1544 kbps, etc...)
- User must provide network monitoring and diagnostics (e.g., PSCN COMM)
- Routers at user sites perform packet switching
 - LAN interfaces (e.g., Ethernet, FDDI, etc.)
 - WAN interfaces (e.g., serial sync lines using V.35, etc.)
 - Switch packets from serial line to serial line or LAN
 - Provide network layer routing

FAST PACKET TECHNOLOGY

USER SITE CONNECTS TO TELCO "CLOUD"

- Single access to TelCo local loop infrastructure
- Telco provides internal cloud redundancy
- Telco packet equipment switches link to link
- Multiple access rates (SMDS @ 1.5, 4, 10, 16, 34 ... Mbps)
- Protocol independent switching at high speed
- Telco provides packet monitoring and diagnostics
- Telco provides service - not links and hardware

ROUTERS INTERFACE SITE TO "CLOUD"

- Routers switch packets only between LAN and Telco 'cloud' - Telco's do high performance switching, and allow routers to do more control!
- Routers still perform network layer routing

FRAME RELAY

ANSI I.122 & Q.931

- Designed for 56 - 1544 Kbps access
- Private addressing scheme (i.e., DLCI)
- Connection oriented
- Each station must be configured with "link" to neighbors
- No multicast capability
- Internally carried as variable length HDLC frames
- Available from carriers now
- Easy to build router interface hardware

Switched Multimegabit Data Service

SMDS (Bellcore specification)

- **Designed for 1.5 - 155 Mbps (extensible to 622 Mbps)**
- **Public addressing standard (E.164 - phone numbers!)**
- **Connectionless datagram protocol**
- **Neighbors can be configured as Virtual Private Net (VPN)**
- **Multicast supported inside the VPN**
- **Internally carried as 53 byte fixed length cells**
- **Available from some LEC's now at 1.5 Mbps**
- **Router interfaces more sophisticated (IEEE 802.6)**
- **Preferred by most LEC's and IXC's for service interface**
- **Requires SONET at 155 Mbps (STS-3c) and above**

Asynchronous Transfer Mode

ANSI T1S1 Group

- **Designed for use at 155 Mbps and above (requires SONET)**
- **53 byte cell transport**
- **Addressing, routing, accounting, congestion & flow control not well defined as yet**
- **Many possible user interface standards (including SMDS)**
- **Also suitable for high speed LAN architectures**
- **Long term goal for Telco internal substrate**

COST CONSIDERATIONS

POINT-TO-POINT LEASED LINES

- T3 price based on T1 price, T1 prices based on 56Kbps, etc.
- Strong price hierarchy to prevent reselling & undercutting supply carrier
- ARC-GSFC dedicated T3 cost = \$3 Million/year
- ARC-GSFC Internal Telco cost significantly less!

SMDS APPROACH

- Prices based on access class (1.5, 4, 10, 16, 34.... Mbps)
- Telcos can trunk internal net using internal cost, since no reselling of leased circuits is possible
- Distance insensitive pricing
- Same switching fabric can support Frame Relay and low speed uses

SMDS Implementation Approach

1. Leverage on DOE/LLNL procurement vehicle in FY92/93
2. Deploy DS-3 SMDS attachments at ARC, GSFC, JPL, LaRC & LeRC in FY93
3. Deploy new routers with DS-3 SMDS support with FDDI ring(s) in FY93
4. ARC and GSFC sites provide interface to T3 NSFnet connectivity via FIX-E and FIX-W
5. Deploy 155 Mbps support in FY94 given budget and requirements
6. Deploy 622 Mbps support in FY95 given budget and requirements
7. Prototype SMDS technology for use in other NASA and Federal programs as a production oriented network service

Issues & Concerns

REMOTE INVESTIGATOR ACCESS

- Assumes investigators are located at well-connected sites
- Future of NSFnet backbone still being defined
- Regionals vary in quality and service (little accountability!)

HIGH PERFORMANCE PACKET SYSTEM

- Vendor support is immature for routers, DSU's, switches
- Lack of Inter-Carrier-Interchange (ICI) protocol support
- IXC deployment of SONET proceeding at lackluster pace
- 155 Mbps and above to NASA sites is critically dependent on LEC SONET deployment
- Dependent on Telco support and deployment schedules
- Routing complexities when interconnecting VPN's over SMDS

SUMMARY

- Focus on meeting NASA HPCC Grand Challenge requirements
- Maximizes use of existing network resources, NASA & non-NASA
- Strongly leverages on telecommunications carrier plans and investments: no private dedicated systems
- Minimizes NASA costs while still providing high performance capabilities
- Fully consistent with national program objective to construct a high performance national network infrastructure
- Provides for strong technology transfer to other programs
- Provides testbed for advanced routing and management designs for large scale public data networks

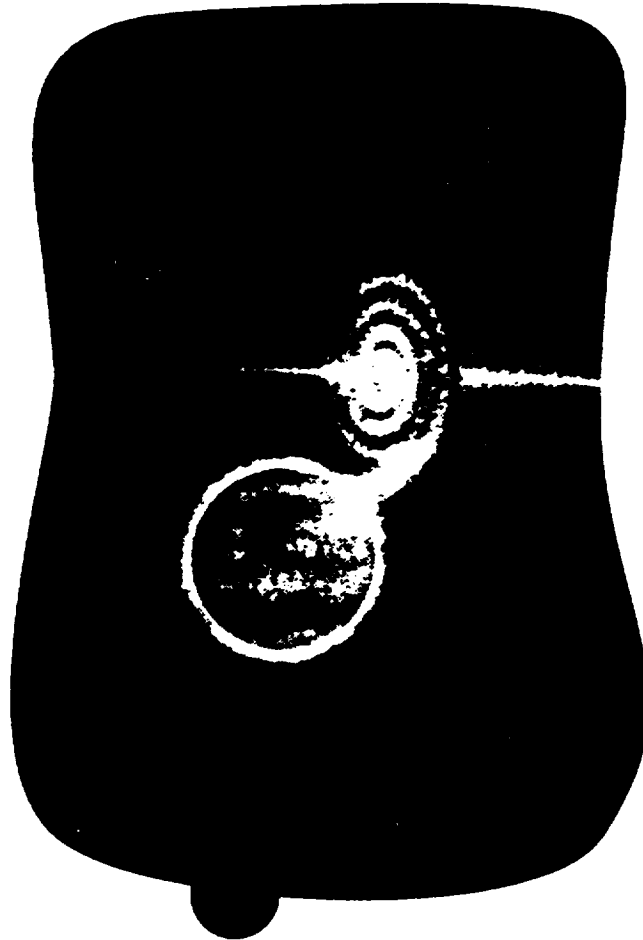
E. Network Applications Technology Plenary

Distributed Visualization

***Horace Mitchell
NASA Center for Computational Sciences
NASA/Goddard Space Flight Center***

NCCS

The User's Perspective



NCCS

My Personal View of Scientific Visualization

Can I coerce my data into a visual image that matches my mental image of what's going on?

Remember the scientific method:

***Hypothesis (mental image)
Experiment (visual image)
Verification (do they match?)***

A scientific visualization is a form of experiment. If the images match I have verification and if they don't I have new information.

NCCS

What characteristics do I, as a user, want in a visualization tool?

- ***A flexible, easy-to-use user interface***
- ***High performance 2D and 3D visualization capability
(fast and/or high quality)***
- ***Adaptable to many scientific disciplines/data types***
- ***Customizable for user-specific requirements***
- ***Scalable from my workstation to a supercomputer***
- ***Usable in three modes:***
 - ***immediate mode
(during computation or data acquisition)***
 - ***analysis mode
(after computation or data acquisition)***
 - ***production mode
(unattended immediate/analysis mode)***

The Randall Report –

In 1986, this report outlined the components that a centralized computer facility should have in order to satisfy NASA's computing requirements for the Space and Earth Sciences.

These components were :

- A Supercomputer***
- A Data Management and Archival System***
- A Central Graphics Facility***
- A High-Speed Network***

The purpose of the Central Graphics Facility would be to provide publication-quality monochrome and color output and movie-making facilities.

NCCS

The Randall Report –

The Randall Report also recognized that much of the smaller-scale analysis and graphic production would migrate to local user workstations that were linked to the central computer facility by the high-speed network.

Since a user would want to do analysis locally and use the central facility for high-quality and/or specialized graphics services, the user's local efforts should interface smoothly with those of the central facility.

What is the role of a supercomputer center in the area of graphics and visualization?

NCCS

The supercomputer center certainly has a role in providing high-end, specialized hardware for visualization.

- ***High-quality/high volume printers***
- ***Professional quality movie making***
- ***High-performance processors for immediate visualization and high-quality rendering***

The supercomputer center also provides software environments:

- ***Testbed environments for introducing users to new methods***
- ***Production environments linked to specialized hardware***

What are the supercomputer support requirements for visualization software ?

- ***Open systems (Unix, X-Windows, PEX)***
- ***Compatibility with existing networks and platforms***
 - ***in-house platforms***
 - ***user platforms***
- ***Distributed processing capability***
- ***Customizable for system-specific requirements***
 - ***specialized production facilities***
 - ***other visualization software***
- ***Vendor and/or user community supported***

It has become increasingly clear that a supercomputer center may not have the resources to develop and maintain its own software.

NCCS

Data Flow Visualizers

Interactive visualizers, user programmable through "data flow networks" composed of system and user-defined elements

- AVS (Advanced Visual Systems Inc.)***
- apE (TaraVisual Corporation)***
- Iris Explorer (Silicon Graphics)***
- Power Visualization Data Explorer (IBM)***

Data flow visualizers combine "visual programming", networked modularity, and customizability

Distributed Visualization at the NCCS

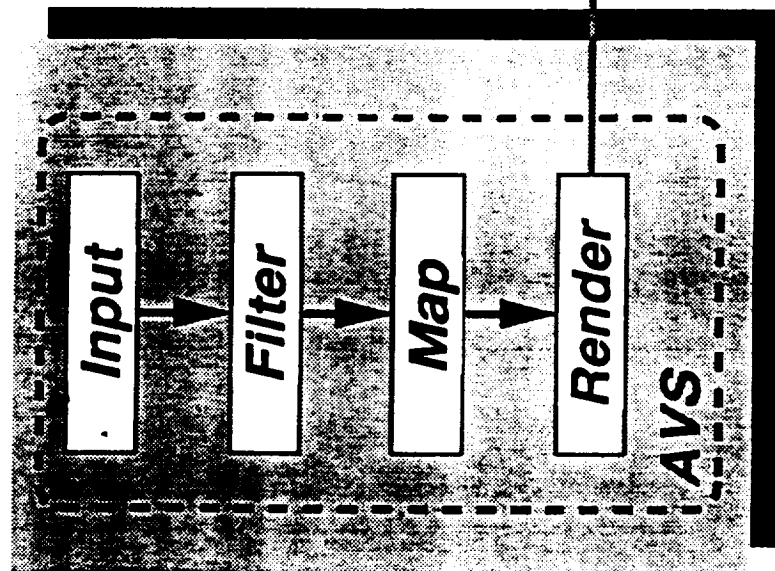
AVS has been identified by the NCCS as the initial software of choice for distributed visualization for a variety of reasons:

- established vendor support over a variety of platforms to support the heterogeneous NCCS user community***
- availability on a major NCCS platform (Convex) as a testbed for NCCS users***
- distributed multiprocessing capabilities over both the NCCS systems and the user workstations***

NCCS

Methods of Distributed Visualization

Convex



Testbed / Low-end

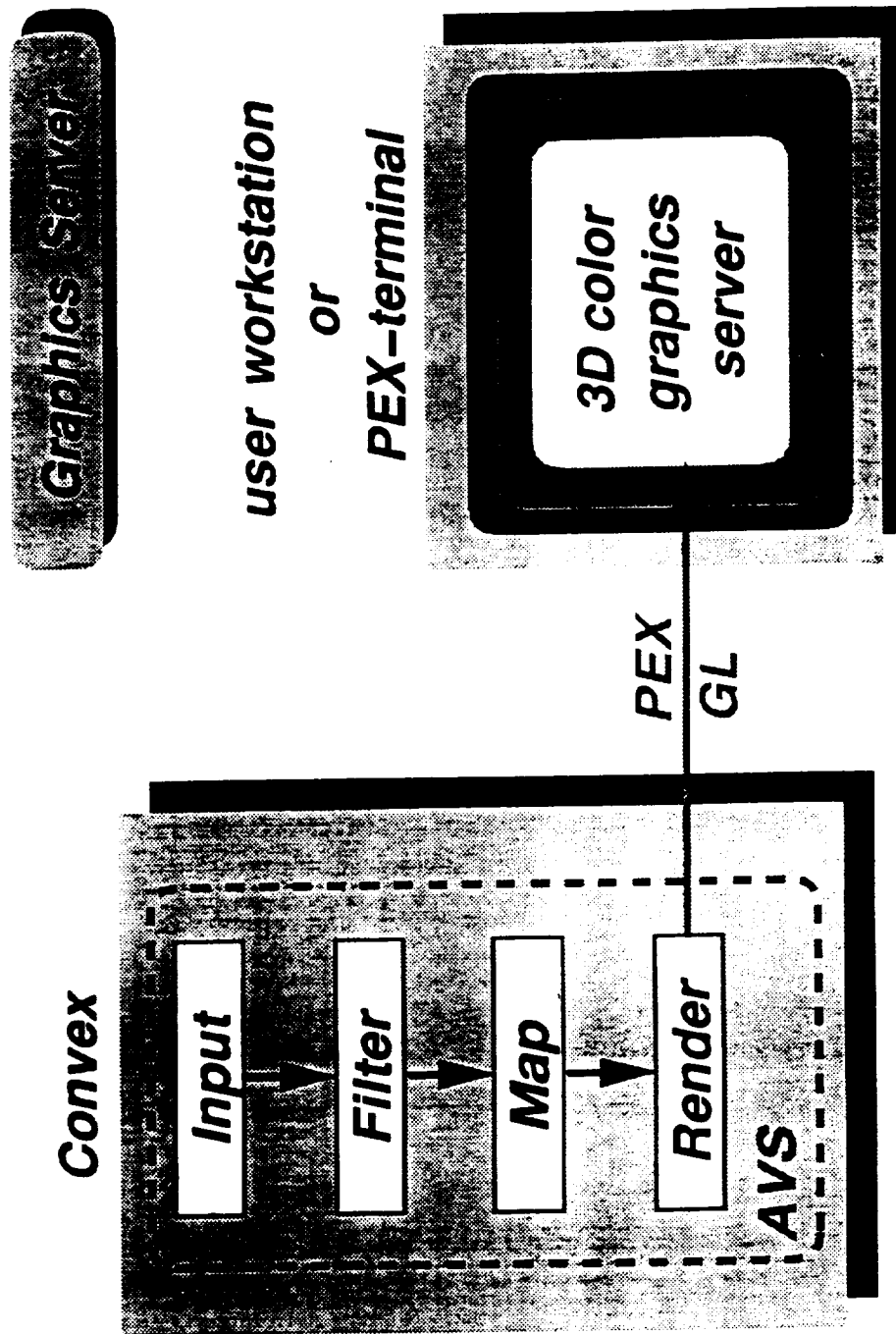
**user workstation
or
X-terminal**



X

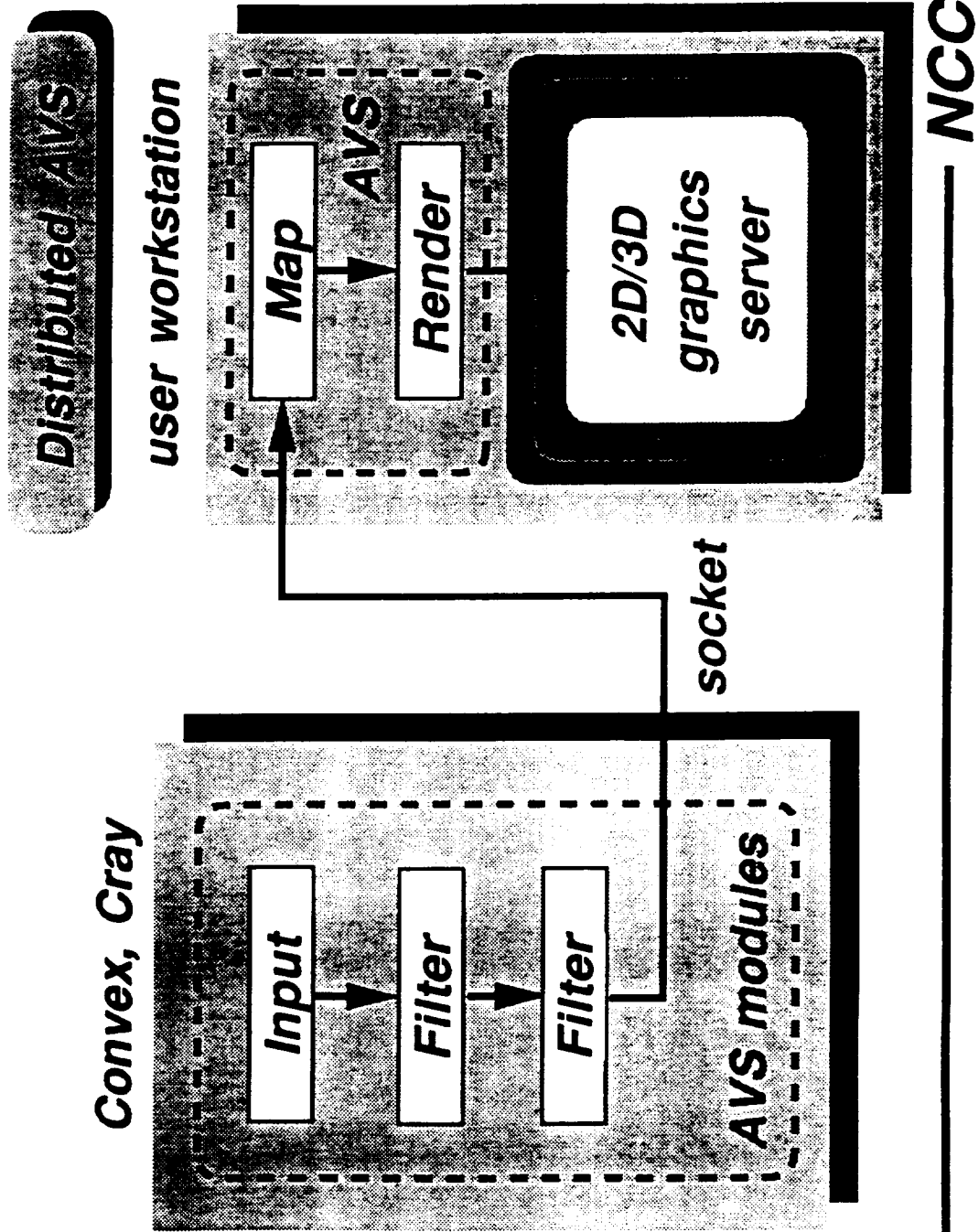
NCCS

Methods of Distributed Visualization

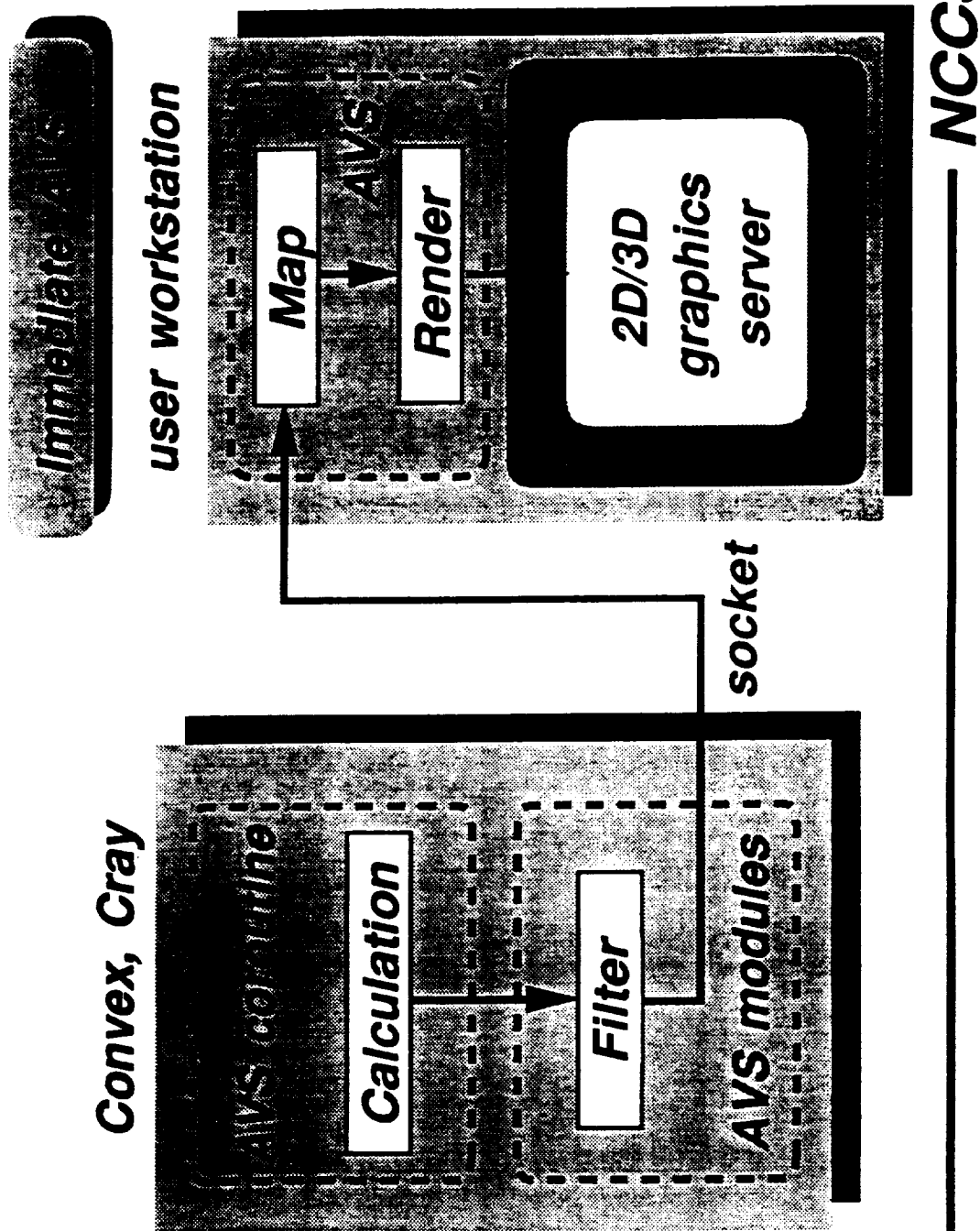


NCCS

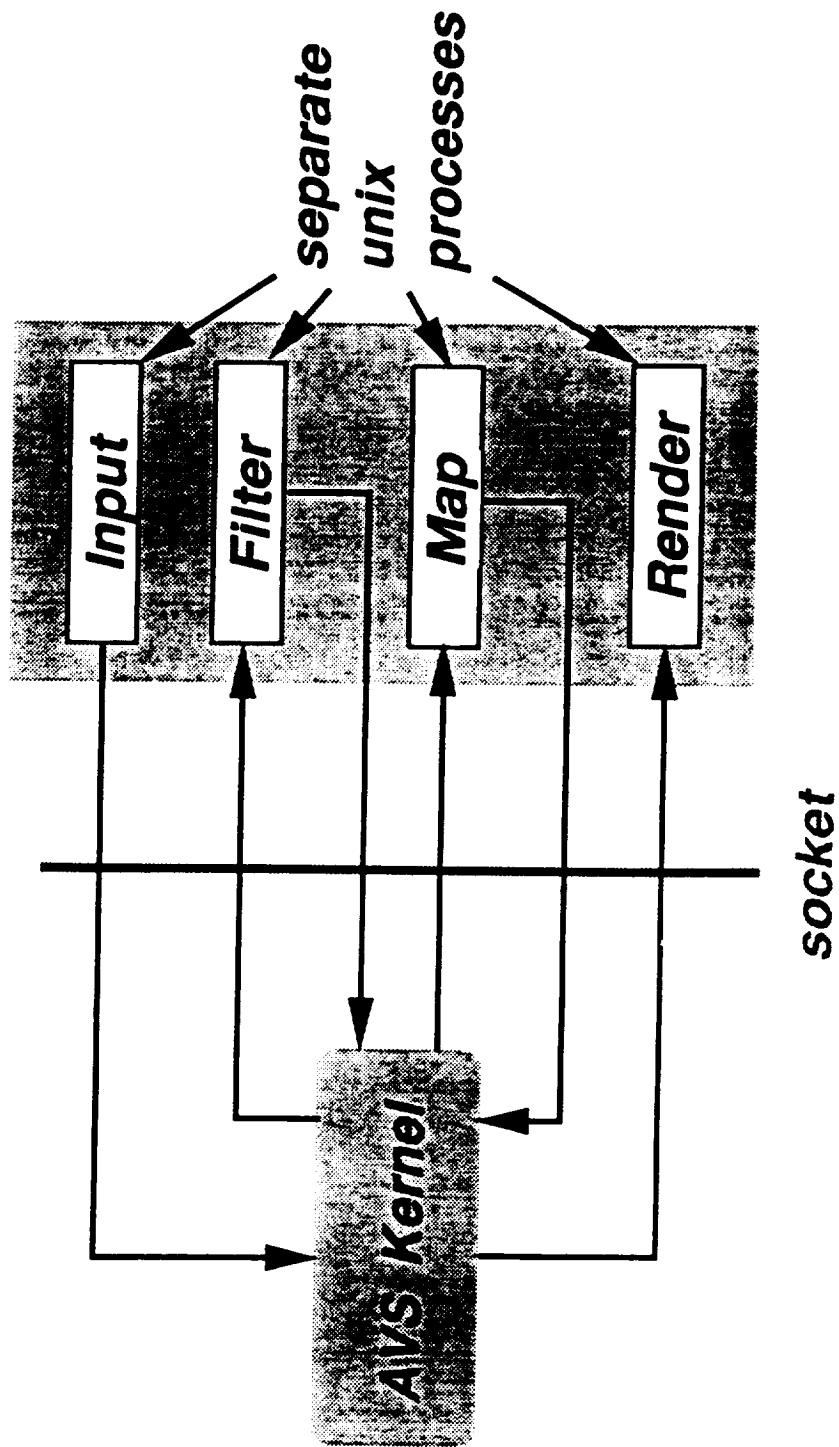
Methods of Distributed Visualization



Methods of Distributed Visualization

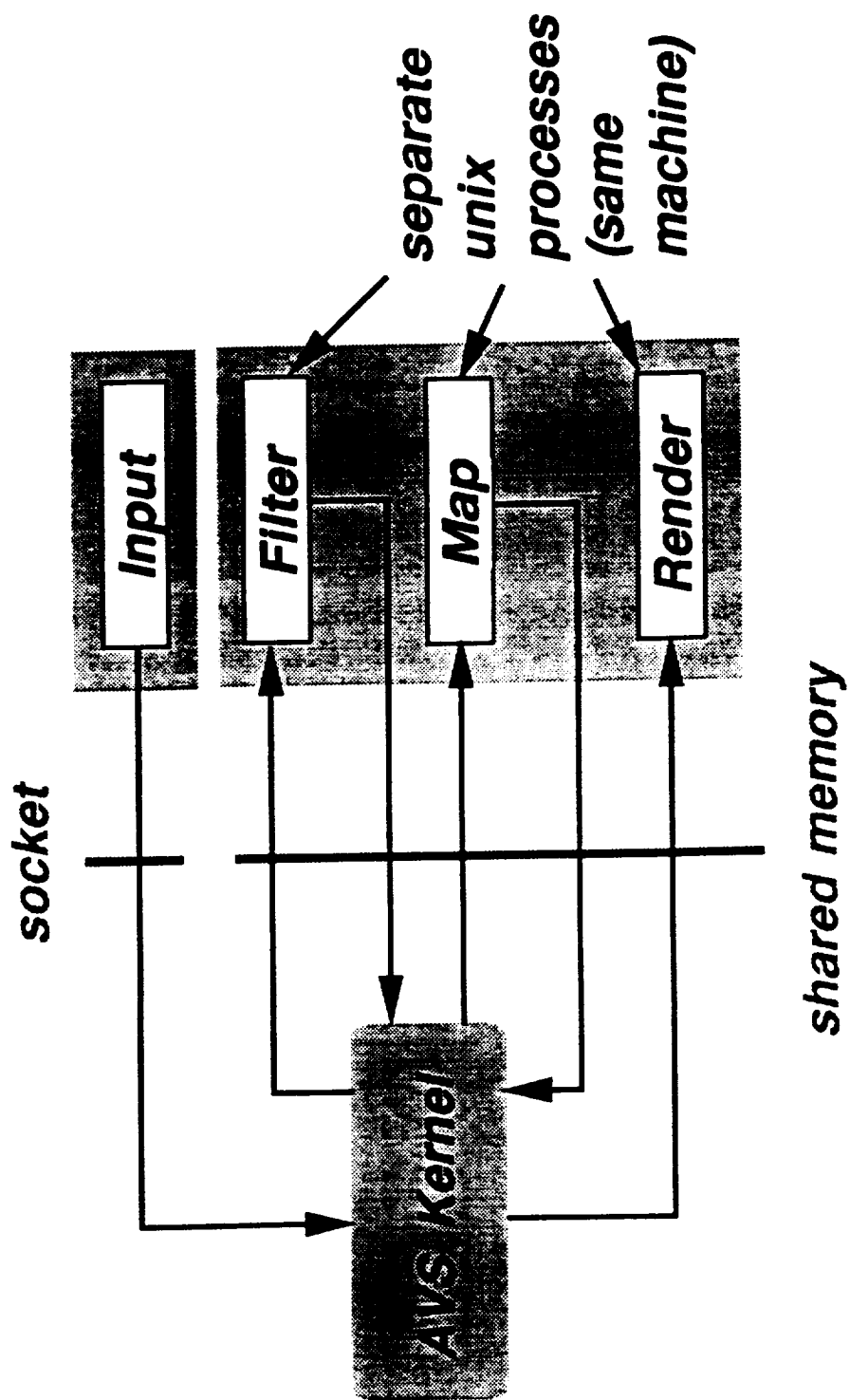


Methods of Distribution within AVS (historical)



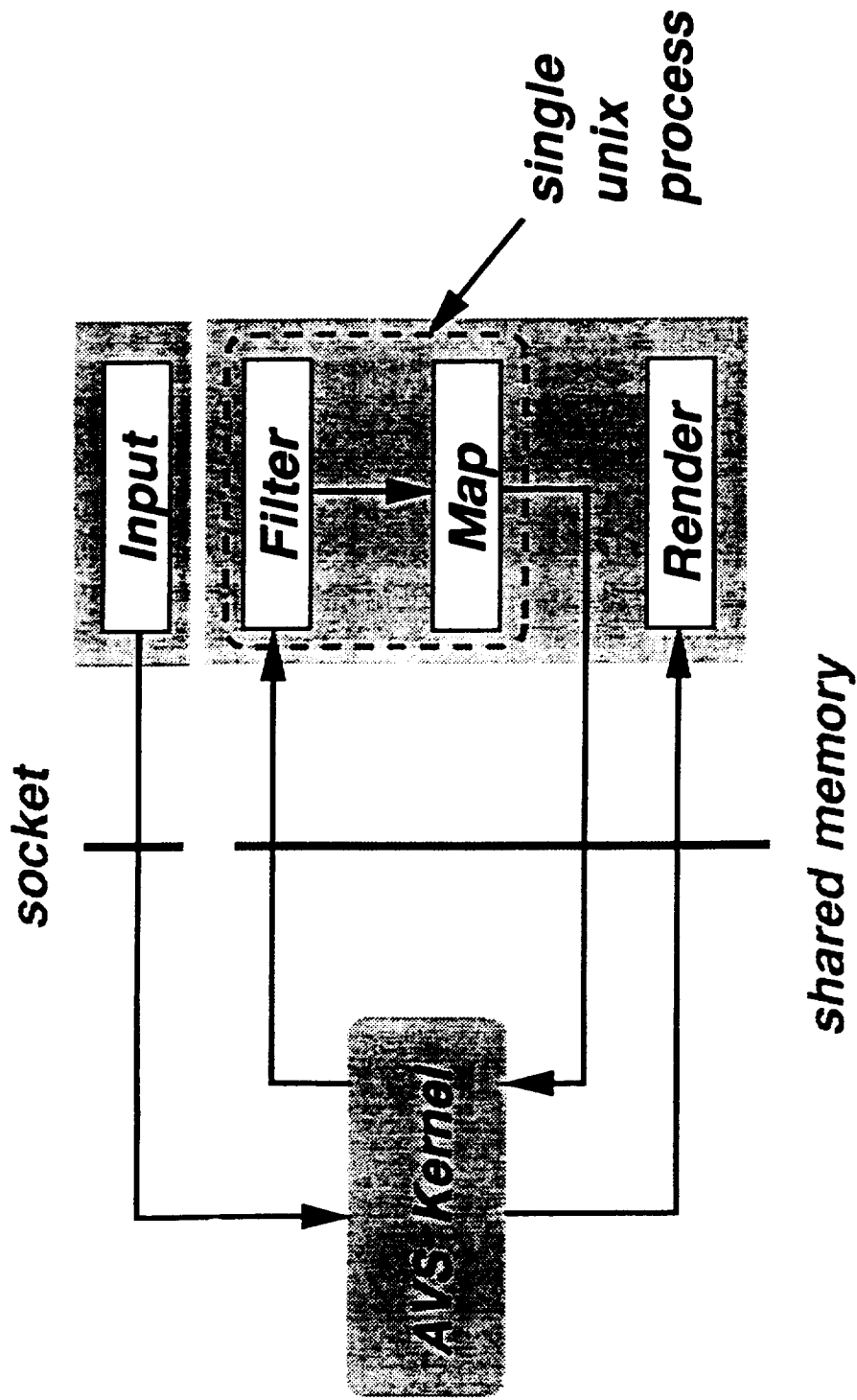
NCCS

Methods of Distribution within AVS (current)



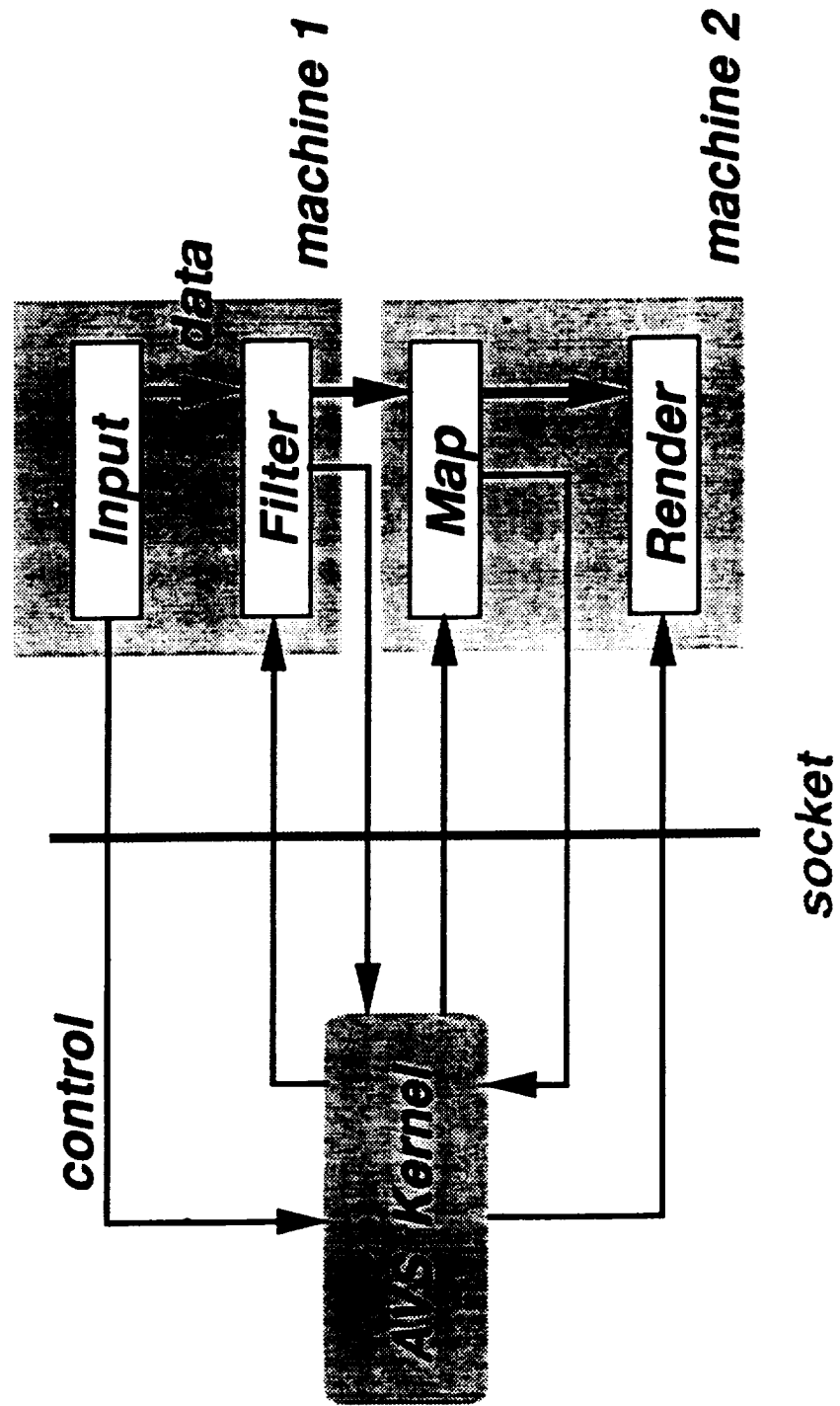
NCCS

Methods of Distribution within AVS (current)



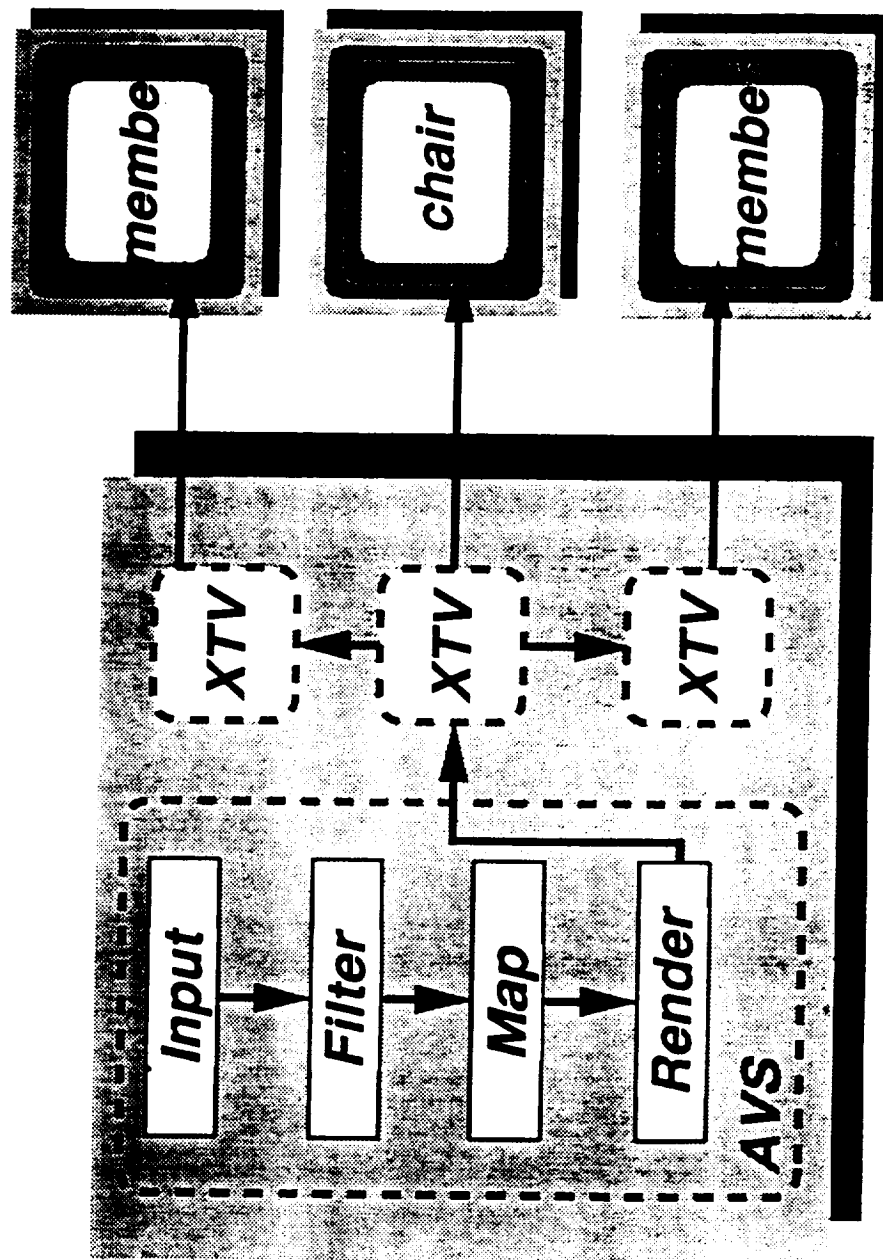
NCCS

Methods of Distribution within AVS (future)



NCCS

Collaborative Distributed Visualization (future)



NCCS

Issues

- **Performance**

A general purpose tool such as AVS tends to be inadequate for high-performance applications such as those requiring large data sets or rapid, interactive animation.

This issue may resolve itself as workstation and network performance improves.

- **Licensing**

Some users are reluctant to commit themselves to an application that cannot be shared with their collaborators without significant expense.

This issue corresponds to the support issue with free license software.

NCCS

Future Directions:

- ***Software Connectivity***

No one environment can satisfy all visualization requirements. A number of vendors are planning software development within AVS or software connectivity to AVS that will expand the scope of the AVS environment.

- ***Parallel Computing***

AVS has been chosen by a number of vendors of parallel computers as a possible software environment. The network programming environment of AVS could separate "front-end" user interface elements from "back-end" high performance computation elements.

Conclusion

The goal of the scientific visualization effort within the NCCS is to provide an environment for scientific visualization that serves as much of its user base as possible.

AVS is our current testbed for providing distributed visualization services due to its scope, modularity, and network transparency.

The NCCS has several other testbed visualization environments involving visualization on high-performance graphics hardware for those tasks which cannot be served by a broad spectrum tool such as AVS.

NCCS

tas.

TAE Plus

Transportable Applications Environment Plus

***A Tool for Building and Managing
Graphical User Interfaces***

Marti Szczur

NASA/Goddard Space Flight Center

NASA Science Internet User Working Group Conference

April 2, 1992

Greenbelt, Maryland

NASA/GSFC

1

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TAE Plus Overview

- Background
- Architecture
- Development Environment
- Runtime Environment
- User Community
- Future Direction

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2

What is TAE Plus?

TAE Plus is a portable software development environment designed to support the

rapid building,

tailoring, and

management

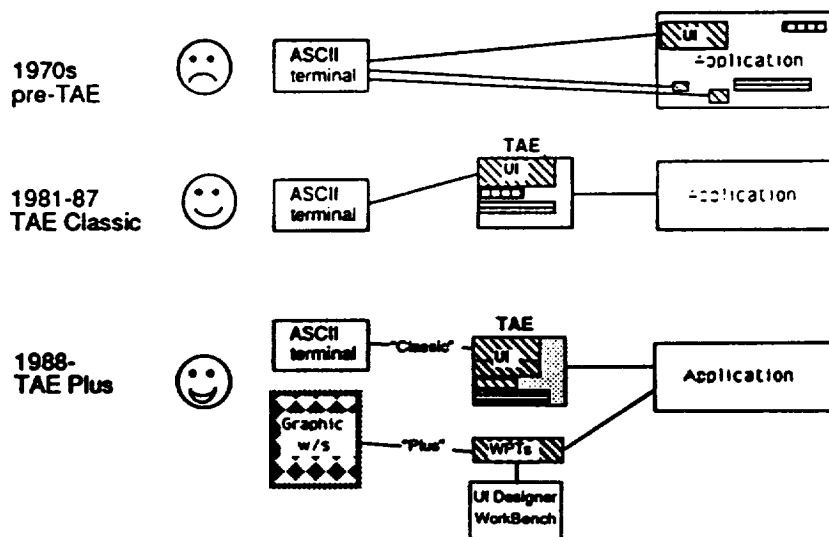
of an application's user interface.

TAE Plus can be viewed as a tool for increasing developer's productivity.

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3

TAE Evolution



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4

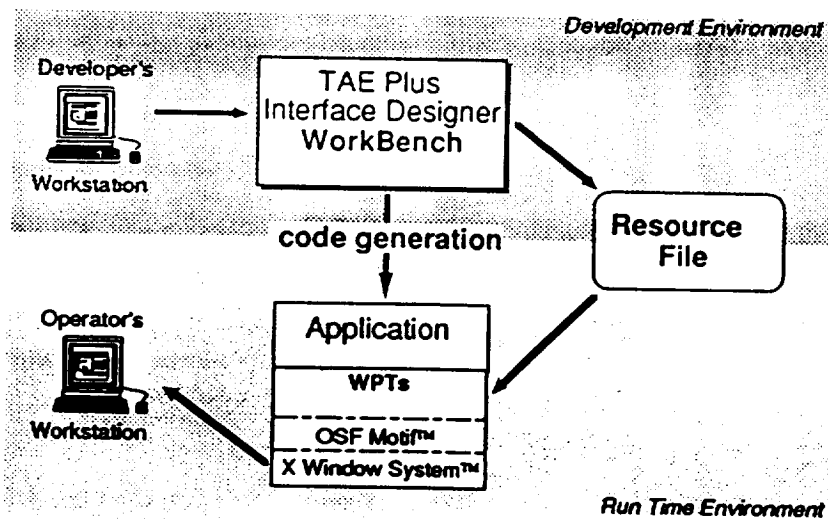
TAE Plus Key Objectives

- **Improve productivity of application UI development**
 - Support WYSIWYG design of the UI elements
 - Support evolution from rapid prototype to baseline system
 - Provide reusable software components
 - Provide less complex set of application services
 - Support for UI expert (who may be a non-programmer)
- **Provide buffer from technology changes**
 - Separate the UI definition from the application
 - Provide application programs with toolkit-independent runtime services
 - Support portability of applications across workstations (e.g., UNIX, VMS)

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5

TAE Plus Environment



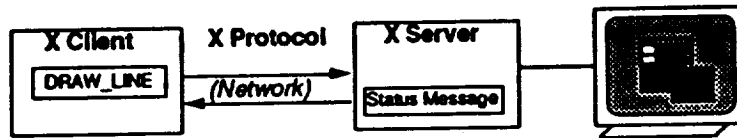
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What does the X Window System provide?

- a standard for device independent window management
 - public domain protocol for window management services
 - low-level graphic and window management primitives
 - MIT's X-Window system is a public domain implementation of the protocol
- support for network interconnection
 - display process (X Server) and application (X Client) can exist on separate machines
 - X Protocol provides the network connection between X Server and X Client

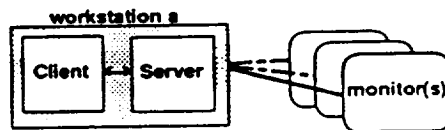


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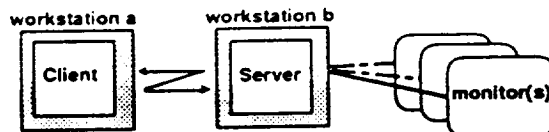
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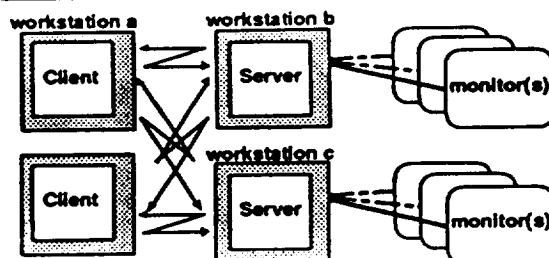
Distributed Applications in X Environment



- single workstation
- no network



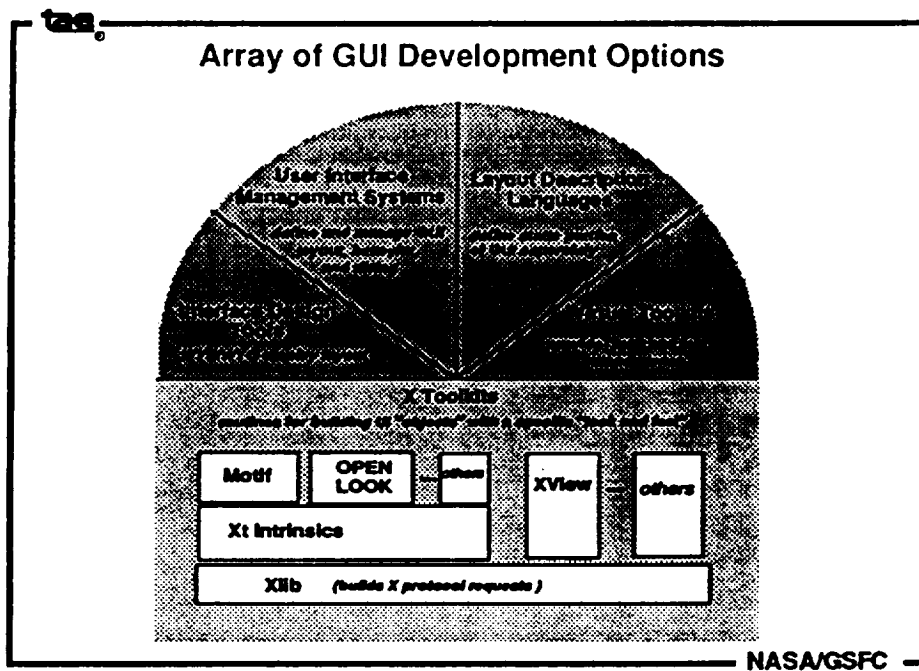
- multiple workstation
- single client/server



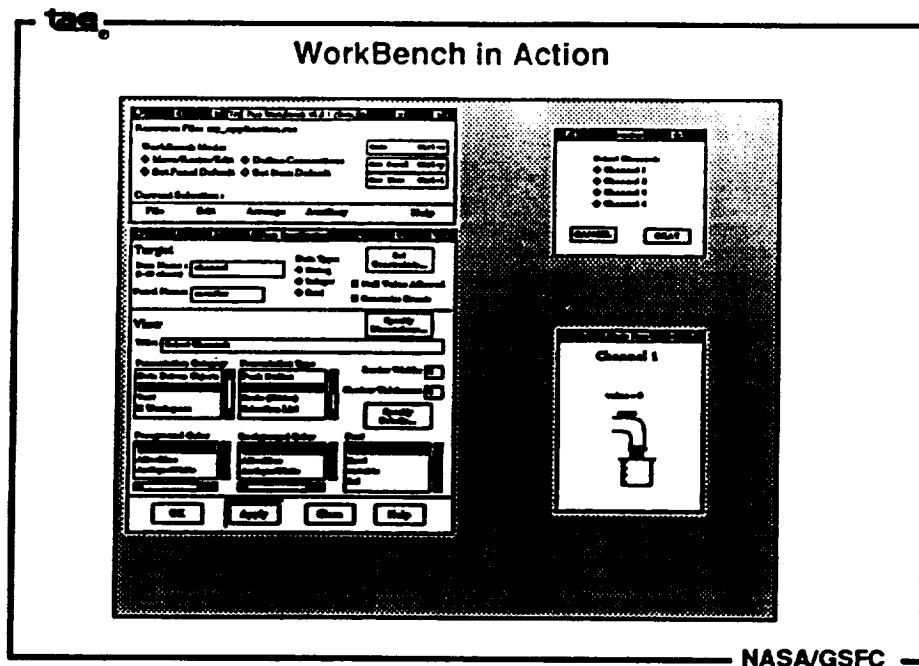
- multiple workstation
- multiple client/servers

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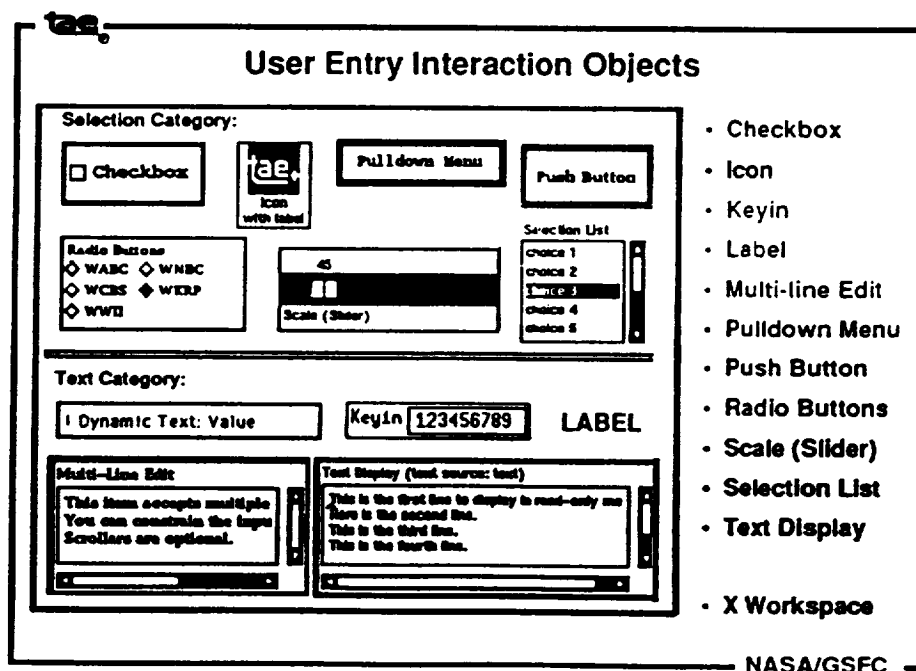
8



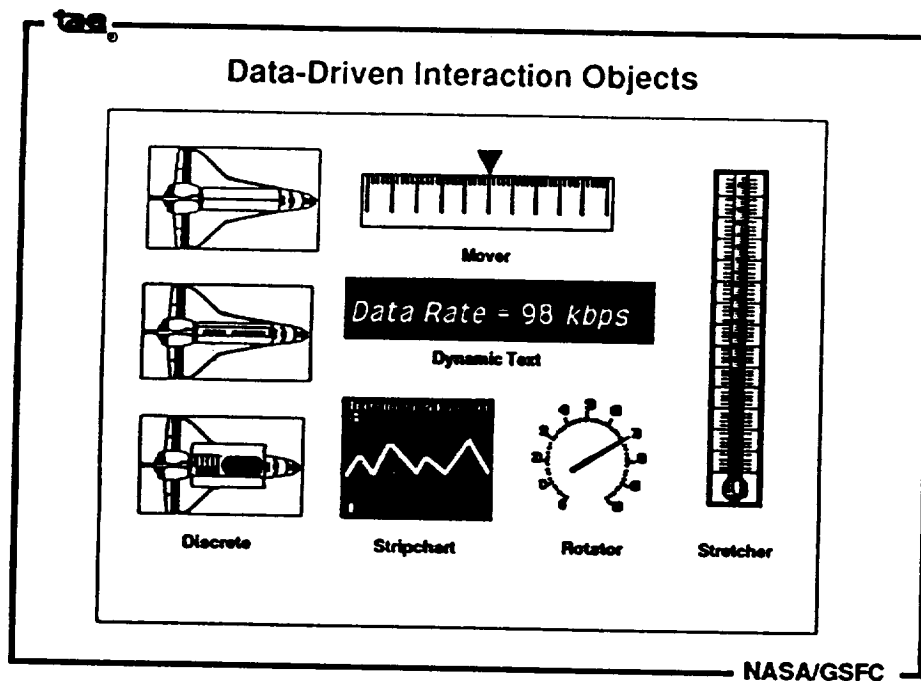
- tas**
- ### TAE Plus WorkBench Functions
- Uses X Window System™ and OSF/Motif™
 - Create, modify and save user interaction objects
 - Support for drawing, editing and saving data-driven objects
 - Define links between user interface objects
 - Rehearse a designed user interface
 - Icon editor
 - On-line help on how to use WorkBench
 - Support for application context sensitive help
 - Generates multi-language application source code (C, Ada, or TCL)
 - Object-oriented (written in C++)
- NASA/GSFC**



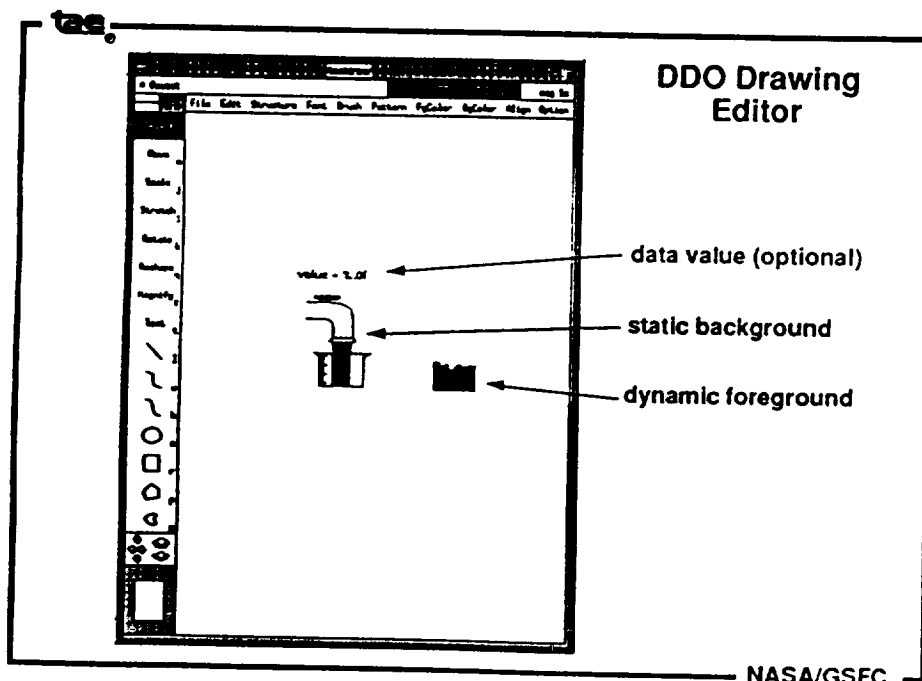
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User Interface Designer Scenario

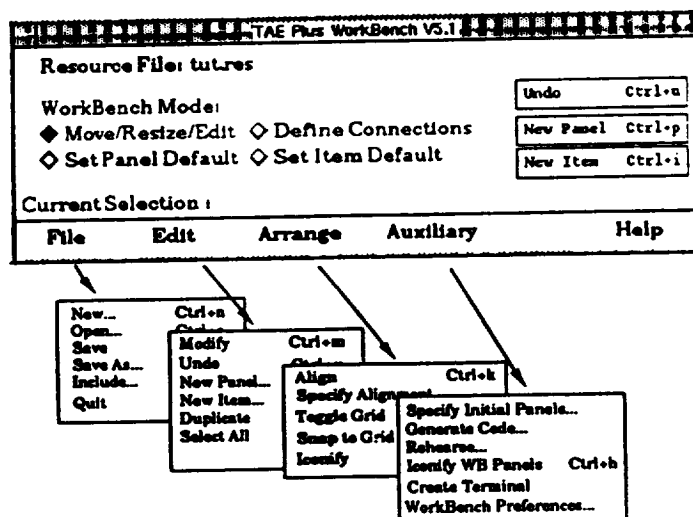
- Create a panel
- Add interaction items
- Include another resource file
- Design icons and DDOs
- Make connections
- Create help information
- Rehearse
- Modify the design
- Generate code

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WorkBench Main Menu



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Panel Specification

Panel Name (1-8 char):

Title:

Foreground Color	Background Color	Font
<input type="text" value="black"/> BlanchedAlmond blue blue3	<input type="text" value="black"/> green green3 GreenYellow	<input type="text" value="times"/> noneB14 noneB18 noneB24 noneB36

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Panel Details

Panel Attributes

Style		
Frame <input checked="" type="checkbox"/> MWM - No Resize <input type="checkbox"/> MWM - With Resize <input type="checkbox"/> Flat Border	Titlebar Functionality <input checked="" type="checkbox"/> TAE Default <input type="checkbox"/> MWM Default <input type="checkbox"/> None	Preferred Panel State <input checked="" type="checkbox"/> Visible <input type="checkbox"/> Visible & Modal <input type="checkbox"/> Invisible <input type="checkbox"/> Iconic <input type="checkbox"/> Part Iconic

Width:

Help File File Name:

Panel Icon File Name:

Width: Label:

Height:

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Item Specification

Target

Item Name: Data Type:
 (1-15 chars) ☐ Null Value Allowed
 Panel Name: ☐ Generates Events

View

Title:

Presentation Category **Presentation Type** **Border Width:**

Foreground Color **Background Color** **Font**

Item Specification

Select New Item from WorkBench Panel

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Item Constraints

Candidate Strings

Enter one string per line.

Candidate ("Valid") Strings

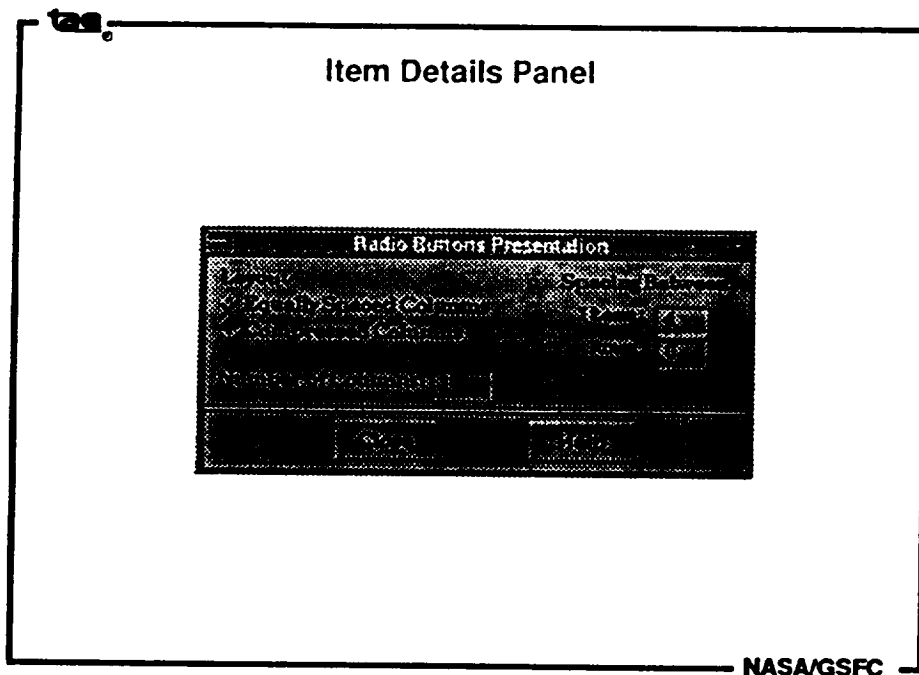
Display
Print
Edit
Delete

Press SetConstraints Button.

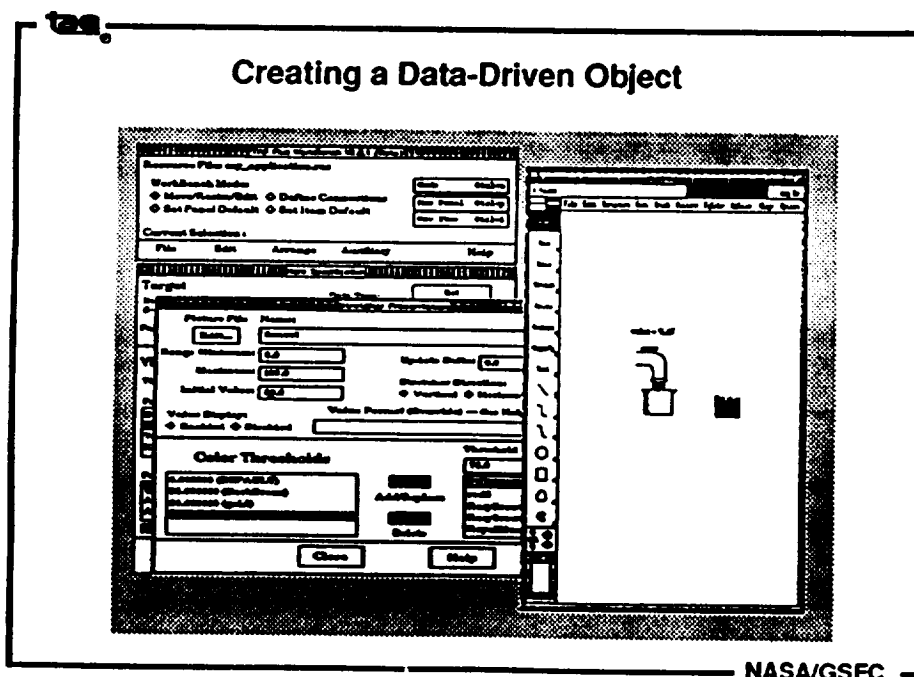
Enter values for radio button list.

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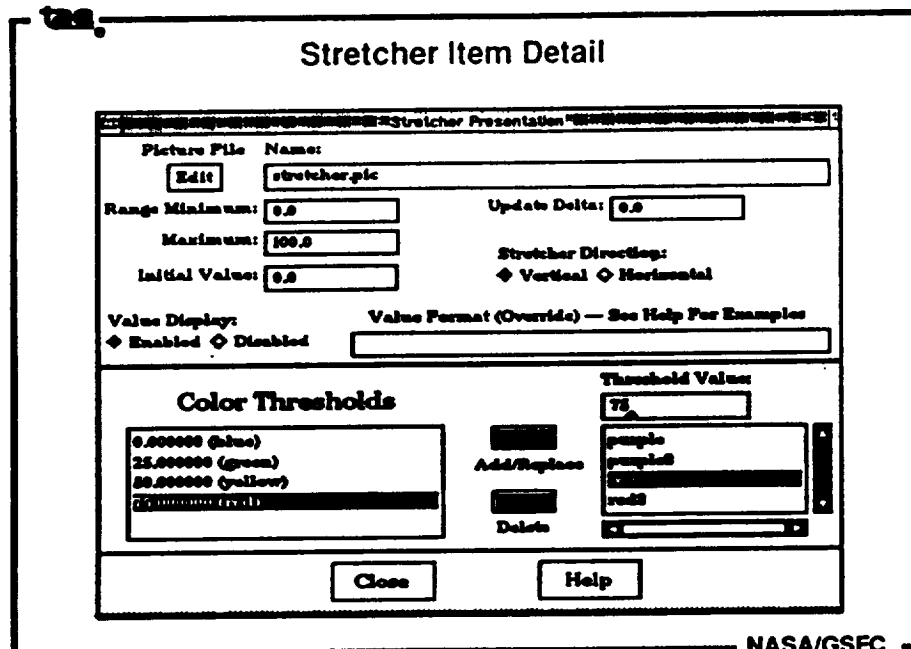
20



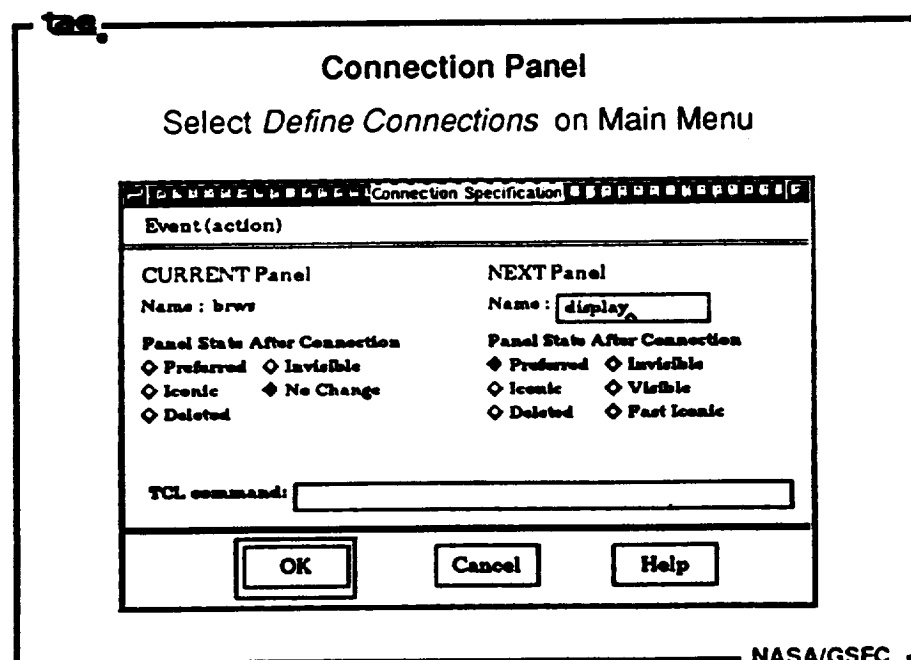
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TAE Command Language (TCL)

- Interpreted
- Interactive or procedural
- General capabilities
 - Intrinsic TAE commands
 - Online help
 - Local and global variables
 - Variable assignment and expressions
 - Macro-level substitution
 - Abbreviated command and parameter names
 - Constructs for conditional execution and looping
 - Proc invocation and inter-proc communications
 - Graphic Window Manipulation

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Create Help Information

- Select yes for "Help Item?" in the presentation panel for a button or an icon.
- Click on "Edit Help File" in the specification panel for the selected panel.

```
.help
    <place panel help information here>

.help action
The action selections are: <fill in help text for each>
Display:

Print:

Delete:

.help select
The selections are: <fill in help text for each>
File A:

File B:

File C:

.help question
```

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Rehearse

- Select *rehearse* under the *Auxiliary ...* menu
- The WorkBench collapses to an icon
- All application panels disappear
- A window labelled "Rehearsal" appears
- The initial application panel is displayed
- Application panels are displayed as prototyped
- Click on WorkBench Icon to restore WorkBench

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Code Generate

Select *Generate Code...* under the *Auxiliary* menu

Application Specification

tutorial

Language	Code Style	Type of diagnostic message
◊ Ada	◊ Multiple Files	◊ Summary Only
◊ C	◊ Single File	◊ Progress and Summary
◊ Fortran		◊ Verbose
◊ TCL		

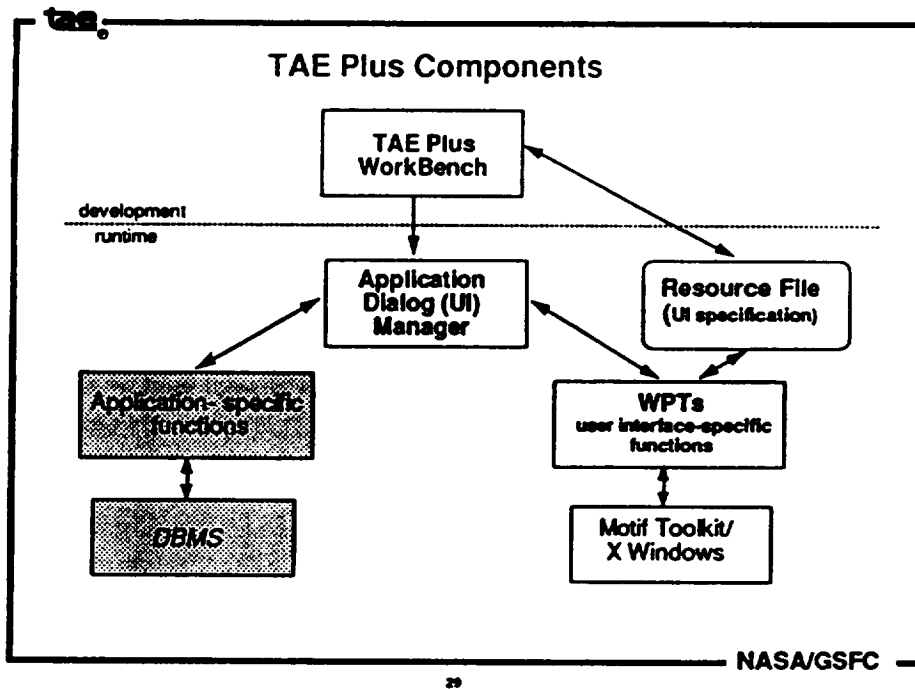
☐ Print diagnostic messages, but don't create files

☒ Generate default print statements in Error Handlers

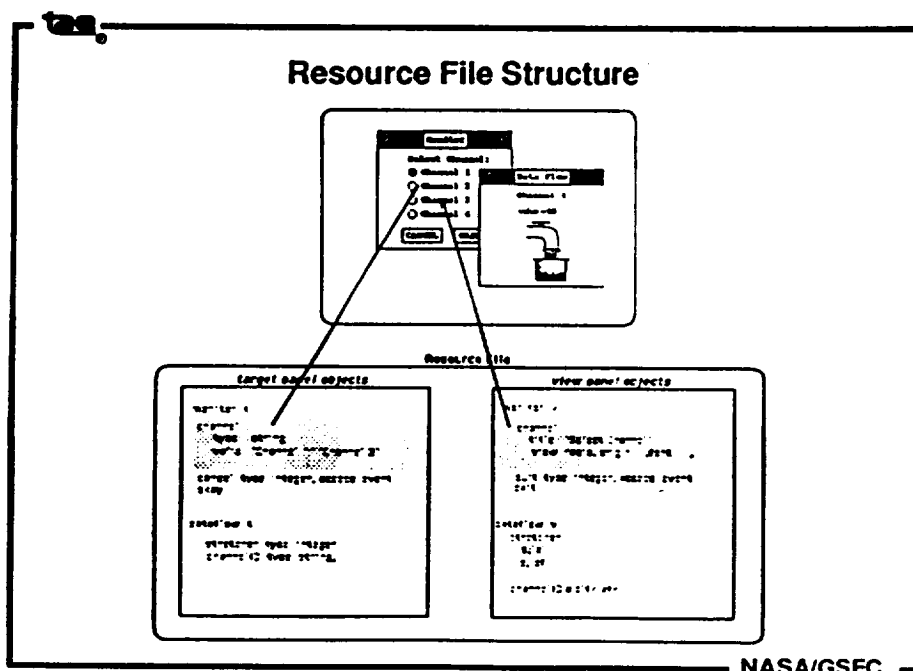
OK Cancel Help

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Why use WPT Services?

- Improve portability of applications
(i.e., shelter from toolkit changes)
- Improve programmer productivity
(i.e., less complex set of routines to master)
- Support multi-language applications
(C, Ada, TCL, C++)

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TAE Plus Application Services (Supporting User Interfaces)

Window Programming Tools (WPTs)

A subroutine package that displays and controls the TAE interaction objects during an application's execution. [40 routines]

Collection Package (COs)

A subroutine package that supports the association and management of groups of TAE objects [8 routines]

Variable Manipulation (VMs)

A utility package that receives, sends and manipulates TAE Plus variable objects. [18 routines]

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WPT Routines

Add/Remove Event	- register other event sources for Wpt to receive
Begin/EndWait	- visual indication that application is busy
CloseItems	- closes items in specified panel
Get/Setxxxx	- set item (data type=xxxx) attributes, values and update displays
Hide/ShowItem	- remove/replace item from/to display
Init	- initialize window system
ItemWindow	- get window ID for specified item
MissingVal	- display botherbox if input value is missing
NewPanel	- create BulletinBoard with items; various states
NextEvent	- get events from displayed items
PanelErase	- erase a panel
PanelMessage	- display dialog box with message(modal)
PanelTopWindow	- return parent shell window
PanelWidgetID	- get toolkit defined panel handle
PanelWindow	- returns window system's window Id

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WPTs, continued

PanelReset	- redisplay panel with initial values for all items
ParmReject	- reject user input; replace with previous value
ParmUpdate	- change an item's target value (as opposed to view)
Pending	- checks if an event is pending
Rehearse	- auto updating of a DDO's value
Setxxxx	- set item (data type=xxxx) attributes, values and update displays
SetTimeout	- set or clear timeout interval for event loop
ViewUpdate	- update item's view (i.e., visual appearance)

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Code Analysis for TAE Plus V5.1

- ≈ 72,000 lines of C and C++ code
- 12 megabyte recommended minimum memory
- .4 - 42 megabytes required disk space
 - .4 mb: TAE runtime libraries, executables only
 - 2 mb: WorkBench executables only
 - 12 mb: no source, no demos, binary libraries
 - 42 mb: all source and all binary libraries, demos
- ≈ 11,000 and 5,500 LOC, respectively, for Stanford's *interviews* and *idraw* packages
- requires X11R4 and Motif 1.1

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TAE Plus Implementations

Validated Ports	User Ports
SUN3/UNIX SUN4/UNIX SparcStation/UNIX Apollo/UNIX HP9000/300 & 700/UNIX DECstation 3100/ULTRIX VAXStation II/ULTRIX 386/486 series IBM 6000 (in progress) MAC II A/UX (V4.1, only) VAXStation II/VMS	Silicon Graphics/UNIX NEC EWS 4800/220 Masscomp/UNIX (V4.1)

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Adding New Presentations To TAE Plus

- Highly modular - almost no change to existing WB/WPT modules
- ~ 150 new lines of WPT code -- in C++
- ~ 100 new lines of WorkBench code -- in C++
- New code may be written using TAE Plus templates
- Involves three basic steps:
 1. Write the widget, compatible with the referenced widget set
 2. Integrate with WPT
 - Make a new presentation type, subclass from WptItem
 3. Integrate with TAE Plus WorkBench
 - Design Presentation panel for the new presentation
 - Add to WorkBench Resource file

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Productivity Case Studies

Case 1: Develop application with realtime object using

- (1) Xt and widgets, directly
- (2) TAE Plus WorkBench and Wpts

Case 2: Develop same interactive application using

- (1) Xlib directly,
- (2) UIL and UIL service routines
- (3) TAE Plus WorkBench

Measure application development time

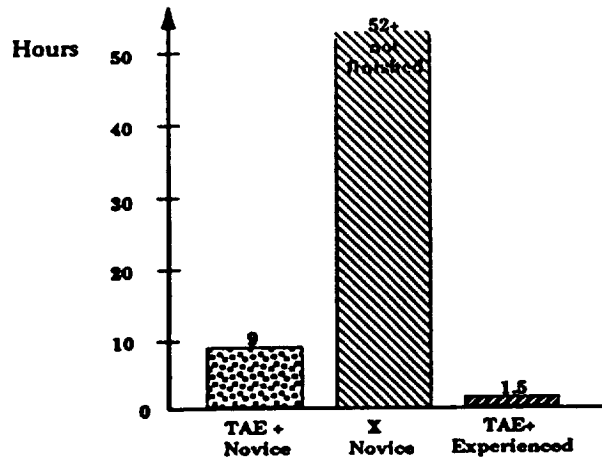
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Development Benchmark 1

A program that has two panels, a few action icons, a radio button bank and a dynamic mover object that moves along a static background when the associated data value changes.



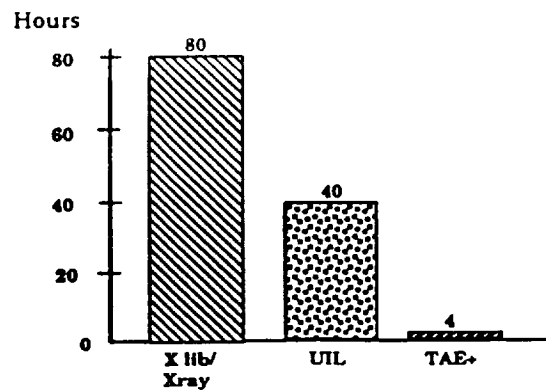
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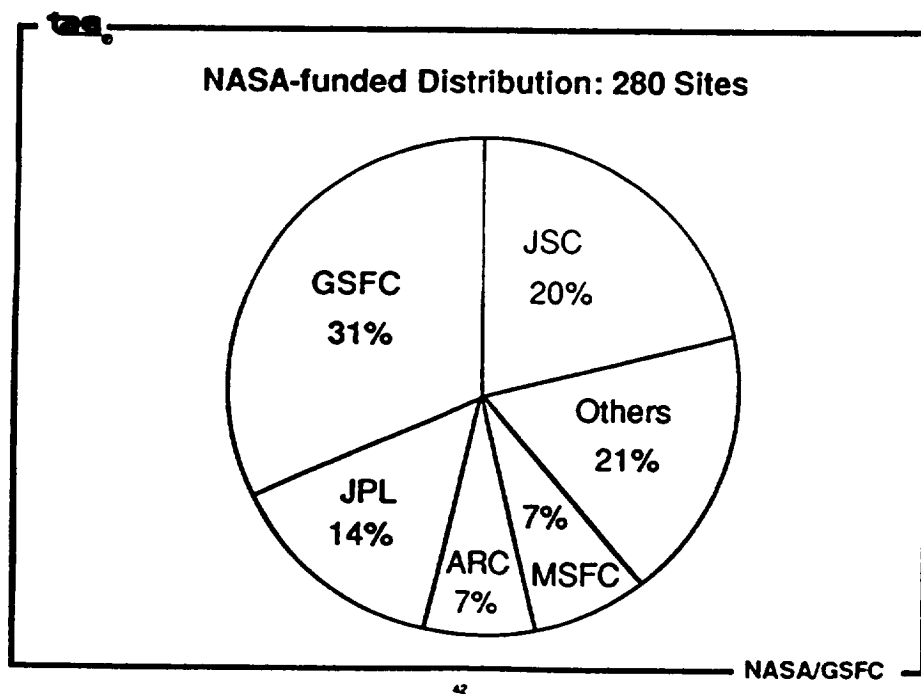
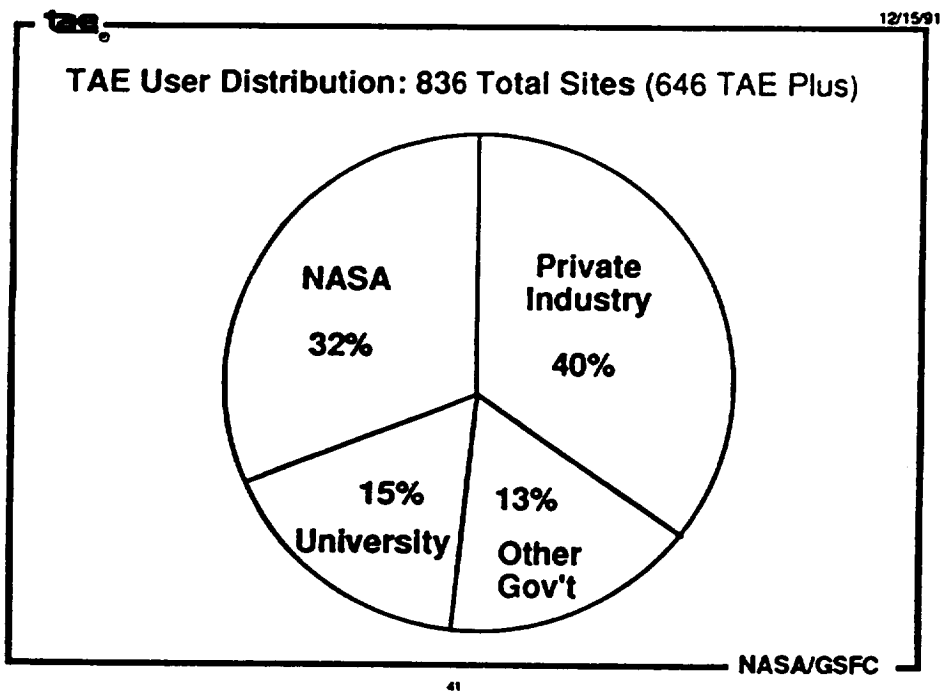
Development Benchmark 2

A screen copy utility which gathers information through radio buttons, action icons, and text input. Then, it sends the information to an HP printer, as well as updating a text widget on the screen.



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Who is Using TAE?

Outside of NASA:

DOD: Army, Navy, Air Force, DIA, DMA, DARPA

Other Gov't: EROS Data Center, Bureau of Land Management, NCAR, NIH, NIST, NSA, NOAA

Universities: C.U., Duke, Boston, Cornell, Georgia Institute of Technology, CalTech, Arizona State, Purdue, UCLA, U. of Md., MIT, Stanford

Private: AT&T Bell Lab, Boeing, CSC, Contel, GE, HP, IBM, Lockheed, McDonnell Douglas, Unisys, GTE, Northern Telecom, Martin Marietta, Battelle, TRW, Apple, Magnavox, GE, Loral, CTA, U.S. West, Westinghouse, Hughes, Mitre, Stanford Telecom, Chrysler Corp., Booz Allen, Rockwell, Harris, PRC, Inc.,

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Who is Using TAE?

Outside of U.S.:

Europe: SASC/Sweden, Imperial College of England, York University/England, Crosfields Electronics Ltd./England, Ford Motor Co., Ltd./England, Université de Paris/France, European Synchrotron Radiation Facility/France, Cap Sesa Regions/France, DFVLA/Germany, Institute of Optoelectronics/Germany, Leading Edge Technology Transfer/Germany, European Space Agency/Netherlands, Computer Resources International/Denmark, Laben Spa/Italy, Istituto Fisbat-CNR/Italy, I.P. Sharp/Canada, CAE Electronics, Ltd./Canada, SED Systems, Inc./Canada

Other: United Nations Environmental (Kenya, Switzerland), New Zealand Government

NASA/GSFC

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tas

TAE User Profile: Application Types

"Check the categories that best describe your application"

Engineering Analysis	33%
Operations/Control	33%
Realtime	24%
Scientific Analysis	24%
Database Application	22%
Near Realtime	18%
Image Processing	16%
Office Automation	2%

NASA/GSFC

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tas

Data Base/Analysis Applications

- GSFC's National Space Science Data Center (NSSDC),
- GSFC's Distributed Access View Integrated Database (DAVID)
- GSFC's International Solar Terrestrial Data Distribution Facility (ISTP DDF)
- Wallops Flight Facility image analysis tool (COLOR)
- JPL's IPAC database search program
- NOAA's user interface to oceanographic database
- U. of MD's Viewcache, access for interoperable databases
- EROS Data Center browse/retrieval of satellite imagery
- Wallops Island's image retrieval/processing system
- Contel's meteorological data retrieval system
- National Library of Medicine browse/retrieval of biotechnology data
- National Cancer Institute's user interface to analysis data base
- JPL's Planetary Data System (PLDS)
- Pennsylvania State University (geographic information)
- USAF Plume Data Center (analysis data base)
- Langley Research Center user interface to atmospheric data
- U.S. Geological Survey (analysis data base for 3-D image cubes)
- Hughes Aircraft (geographic data base)
- Shell Development Co. (user interface for DBMS)
- Stanford's Solar Oscillations Imager

NASA/GSFC

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Operations/Control Related Applications

- GSFC's Packet Processor Enhanced Front End & Control System
- CU's Operations and Science Instrument Support System (OASIS)
- GSFC's Request-Oriented Scheduling Engine (ROSE)
- GSFC's Network Control Center User Planning System (NCC/UPS)
- Georgia Tech's Multi Operations Control Center Simulator (GT-MSOCC)
- GSFC's Generic Telemetry Simulator (GTSIM)
- GSFC's International Solar Terrestrial Physics Central Data Handling Facility
- Air Force's Tactical Air Combat Simulation (TACS)
- GSFC's Space Network Control System prototype scheduler
- Army's Tactical Command and Control System
- Martin Marietta's Access Control System for secure network access
- ESA's Columbus Crew Workstation prototyping
- General Dynamic's Real-Time Control System for Ground Operations
- Army's Operation Order Generation for Battalion and Below Command and Control Program
- GSFC's SAMPEX Command Management System
- MSFC's ECLSS Process Control Prototype
- Lockheed's Advanced Tomahawk Weapons Control System
- JSC's Shuttle Mission Control Center Upgrade (MCCU) for TSS Mission
- Northern Telecom's Technical Assistance Service (TAS) System

NASA/GSFC

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Primary Concerns

• Performance

- all events/messages go across network
 - *distribute UI manager/dispatcher with server*
 - *display and hide UI elements*
- multiple software layers (Xlib, Xtoolkit, WPTs)
- workstation limitations

• Size

- overhead to application code includes X, Motif, WPT
- not currently utilizing shared libraries

NASA/GSFC

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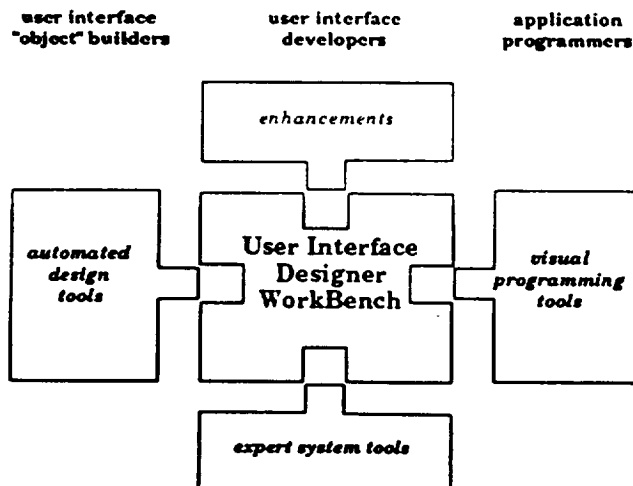
What Sets TAE Plus Apart from Other Motif Tools?

- User Focus (ease-of-use for UI design professional)
- Spans all tool categories (virtual API, layout description language, interactive design tool, UIMS)
- Higher level API abstraction
- Data-driven objects
- Help facility
- Auto constraint checking
- Support for WYSIWYG panel connections
- Code generation for multiple programming languages
- TAE Command Language
- Dynamic resource file (no compiling; make changes during runtime)
- Source code included
- Government software (low cost, liberal license)
- User support (technical advice, newsletter, conferences)

NASA/GSFC

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Future Directions



NASA/GSFC

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TAE Plus V5.2 Features

- New interaction objects: Menu Bar with Cascading Menus, Option Menu, File selection dialog, Message boxes (error, information working, warning, question)
- Support for Accelerators/Mnemonic specification
- Improved color/font selection
- Scrollable panels and workspaces
- C++ code generation
- Support for multiple console displays and screens
- Support for tabbing/traversal
- Help and message panel tailoring
- Support for object stacking

NASA/GSFC

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Acknowledgements

TAE Plus is available from COSMIC, the NASA Software Distribution Center located at the University of Georgia.
(404) 542-3265

The TAE Support Office is located at GSFC and is available to answer questions and distribute information.
(301) 286 - 6034

TAE Plus development is sponsored by the NASA Office of Space Operations.

TAE Plus is being developed with the prime contractor, Century Computing, Inc.

TAE™ is a registered trademark and service mark of NASA.

TAE Plus uses the Open Software Foundation's Motif™ and MIT's X Window System™

NASA/GSFC

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F. User Services and Applications Subgroup Presentations

User Services Planning
in the Internet

NASA Science Internet
Users Working Group

30 March – 3 April 1992

Joyce K. Reynolds
Information Sciences Institute
University of Southern California
Marina del Rey, California
USA

Overview

GLOSSARY

1. Glossary

2. Internet Society

3. IETF User Services

4. RFCs

ISOC = Internet Society

IAB = Internet Activities Board

IRTF = Internet Research Task Force

IETF = Internet Engineering Task Force

RFC = “Request for Comments”
document

FYI = “For Your Information”
document

INTERNET SOCIETY

- * Organizers: CNRI, EDUCOM, RARE
- * Seeking Other Interested Parties
- * General Operations: Started 1 Jan 92
- * Individual and....

Founding Organizational
Members are invited to
join now

INTERNET SOCIETY

GOALS

- * Multiprotocol Evolution
TCP/IP, OSI,...
- * Encourage Internet Growth
- * Educate the Public
- * Stimulate Provision of Service
- * Recognize Individual Contribution
- * Promote and Explore Scientific,
Educational, Business Use
- * Facilitate Collaboration

INTERNET SOCIETY

ACTIVITIES

- * Evolution of Internet Technology
- * Incorporate IAB, IETF, IRTF
- * Newsletter and Journal
- * Annual Conference: INET
INET 92: June 15-19, 1992
Kobe, Japan
- * Possible Infrastructure Assistance

- CERT-System
- Crypto-Certificates
- Internet Registry
- Referral Services

INTERNET SOCIETY SUMMARY

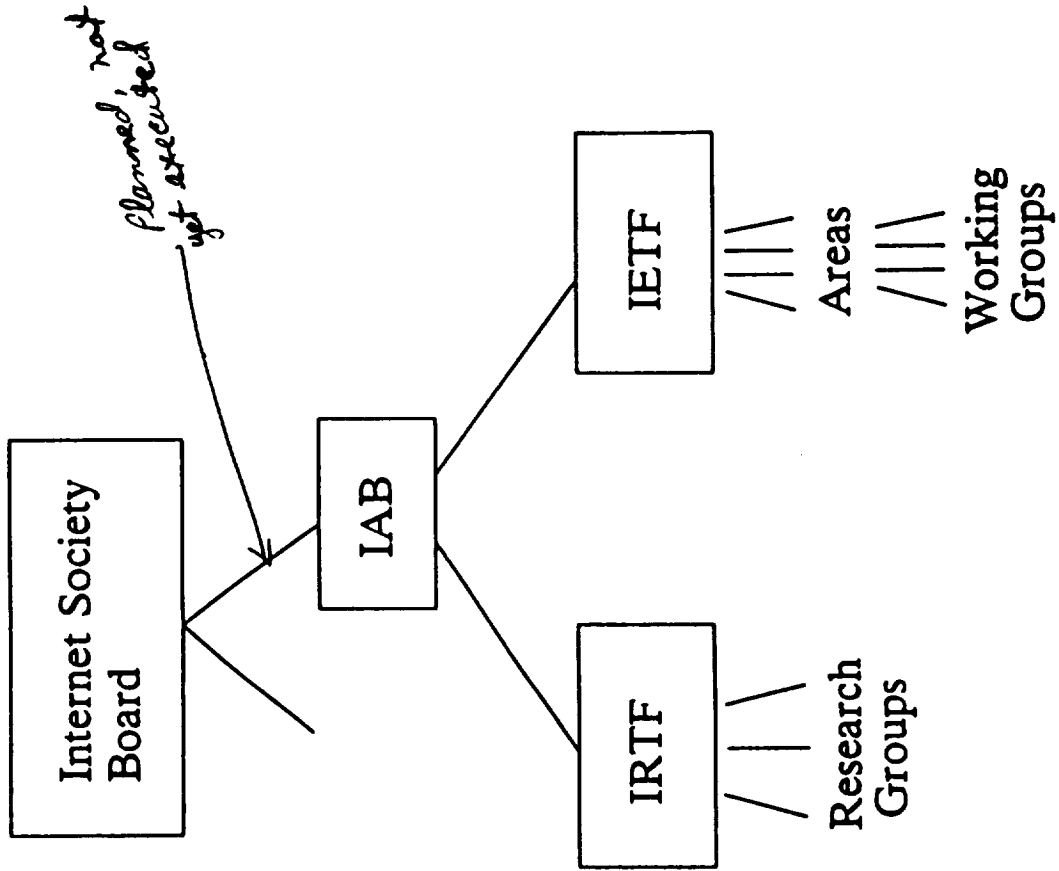
- * Nourish the Community now
growing up around networks.
- * Our packets cross borders
freely and our sense of
community should be equally
open.
- * Continue the Grand Collaboration
^{7,500}
now linking ~~5,000~~+ nets and
~~3,000,000~~+ people, ^{700,000} *hosts*
4,000,000+

FOR MORE INFORMATION...

ISOC@NRI.RESTON.VA.US

FAX: +1 703 620 0913

TEL: +1 703 620 8990



**IETF User Services
Working Groups and
Projects**

**Directory Information Services
Infrastructure (DISI)
Internet Anonymous FTP Archives
(IAFA)
Internet School Networking (ISN)**

**Network Information Services
Infrastructure (NISI)
NOCTools**

User Documentation (UserDoc)

User Glossary (UserGloss)

User Services (USWG)

User Services Area Council (USAC)

**Directory Information Services
Infrastructure (DISI)**

Chaired by Christopher Weider

**DISI chartered to facilitate deployment
of X.500 Directory Services on the
Internet, by producing "Administrator's
Guides".**

**Current working Internet-draft:
"Executive Introduction to Directory
Services using the X.500 Protocol".**

Internet Anonymous FTP Archives (IAFA)

Chaired by Peter Deutsch
and Alan Emtage

IAFA is chartered to
define a set of recommended
standard procedures for the
access and administration
of anonymous ftp archive
sites on the Internet.

Internet School Networking (ISN)

Chaired by

John Clement
Art St. George
Connie Stout

ISN is chartered to facilitate
the connection of the United States'
K-12 (Kindergarten-12th Grade)
schools, public and private, to the
Internet, and promote school
networking in general.

NOCTools

Chaired by Robert Enger
and Darren Kinley

“Son of NOCTools” is updating and revising their catalog to assist network managers in the selection and acquisition of diagnostic and analytic tools for TCP/IP Internets.

Network Information Services Infrastructure (NISI)

Chaired by April Marine
and Patricia Smith

NISI is exploring the requirements for common, shared Internet-wide network information services. The goal is to develop an understanding for what is required to implement an information services “infrastructure” for the Internet.

Current working Internet-draft:
“Building a Network Information
Services Infrastructure”

User Documentation (UserDoc)

Chaired by Lenore Jackson
and Ellen Hoffman

User-Doc is preparing a revised bibliography of on-line and hard copy documents/reference materials/training tools addressing general networking information and how to use the Internet. (Target audience: those individuals who provide services to end users and end users themselves.)

User Glossary (UserGloss)

Chaired by Gary Malkin and
Tracy LaQuey Parker

User-Gloss is chartered to create an Internet glossary of networking terms and acronyms for the Internet community.

User Services (USWG)

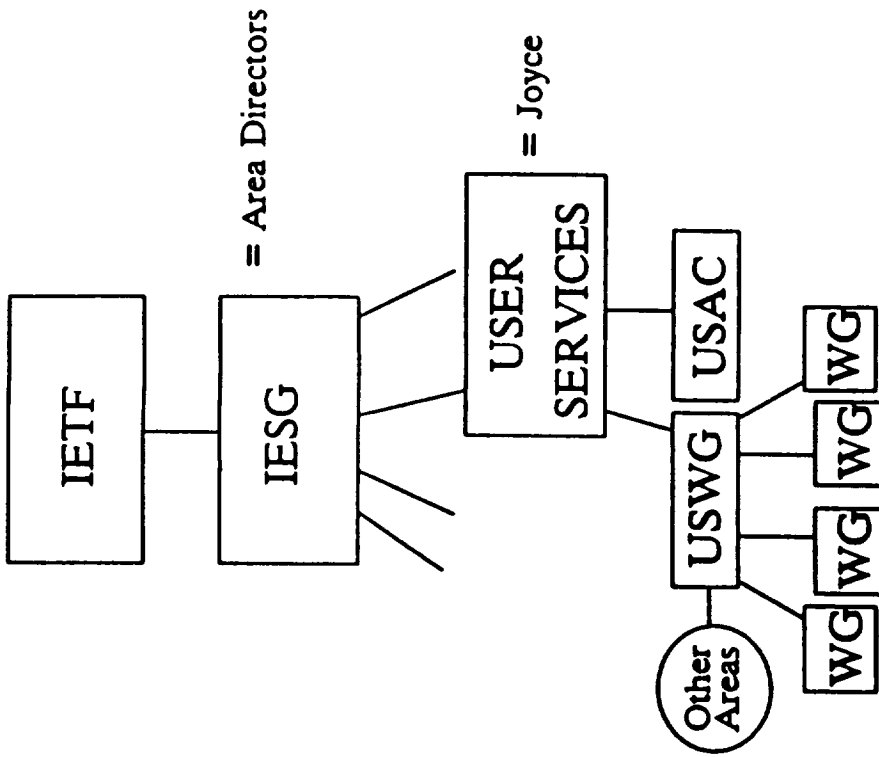
The User Services Working Group provides a regular forum for people interested in all user services to identify and initiate projects designed to improve the quality of information available to end-users of the Internet.

User Services Area Council (USAC)

USAC is responsible for researching and defining short term and long term user services needs internationally, and coordinating developments in finding solutions.

Philosophy for Membership

- 1) People are selected as individuals, NOT representatives of organizations, countries, networks, or anything else.
- 2) We like to have people with a variety of backgrounds and experience.



IETF User Services Area Plan

Seven types of User Services objectives:

- **User Information**
- **Network Information Services
Infrastructure**
- **Network Operational Management**
- **Education**
- **Documentation and Distribution**
- **Interaction with IESG Areas**
- **Interaction with other international
user services entities**

- User Information

The Internet community requires up-to-date, basic Internet knowledge and experience. These can be achieved by publication of handbooks, bibliographies, directories, and glossaries. Yet, how does the IETF “get the word out” beyond the normal distribution and announcement via the RFC series??

Identification and research on various existing distribution resources, and consideration of possible long term distribution methods are required.

- Network Information Services
Infrastructure

A global infrastructure for common shared Internet-wide network information services is needed.

Research and development for an information services “infrastructure” for the Internet community.

Documentation of methods for the interaction and cooperation among NICs.

We intend to coordinate closely with other efforts in the international networking community.

- Network Operational Management

This topic overlaps with other IETF Areas such as network management, operations, and applications. Yet, development of general information to users is essential.

The User Services Area intends to contribute by providing documentation that will be developed in tandem with technical specifications.

- Education

The educating of new network users is mandatory.

For teachers, trainers, etc., provide organized Internet tutorials, “hands on” training programs, active participation in the K-12 education initiative, and Internet specific documentation.

- Documentation and Distribution

Coordinate the development of informational documentation and distribution methods for the Internet community.

FYI RFCs are introductory and overview documents for network users. Their purpose is to make available general information, rather than the protocol specifications or standards that is typical of other RFCs.

- Interaction with IETF Areas

Coordination with other IETF Areas to work together on topics of common interest.

- International Cooperation

Interaction with other international user services organizations.

Helping New Users

Task for the Networks
(e.g., Regionals)

-Newsletters

-New User Guides

-Etc., etc.

IETF User Services is second level. Dealing with real users is first level. IETF User Services provides information to people doing first level services.

Liaison Role

Promote information sharing
and cooperation between
Network Information
Centers.

SRI NISC

Merit

BBN NNSC

CERF-NIC

Others

Internet Documentation
for USERS (not WIZARDS!):

FYI RFCs

FYI 11 "A Catalog of Available X.500
Implementations", Jan. 1992.

FYI 10 "There's Gold in them thar
Networks! or Searching for
Treasure in all the Wrong Places",
Dec. 1991.

FYI 9 "Who's Who in the Internet:
Biographies of IAB, IESG and
IRSG Members", Aug. 1991.

FYI 8 "Site Security Handbook",
Jul. 1991.

FYI 7 “FYI on Questions and Answers:
Answers to Commonly Asked
“Experienced Internet User”
Questions”, Feb. 1991.

FYI 6 “FYI on the X Window System”,
Jan. 1991.

FYI 5 “Choosing a Name for Your
Computer”, Aug. 1990.

FYI 4 “FYI on Questions and
Answers: Answers to Commonly
asked “New InternetUser”
Questions”, Feb. 1991.”

FYI 3 “FYI on Where to Start: A
Bibliography Internetworking
Information”, Aug. 1990.

FYI 2 “FYI on a Network Management
Tool Catalog: Tools for
Monitoring and Debugging
TCP/IP Internets and
Interconnected Devices”,
Apr. 1990.

FYI 1 “F.Y.I. on F.Y.I.: Introduction the
F.Y.I. Notes”, March 1990.

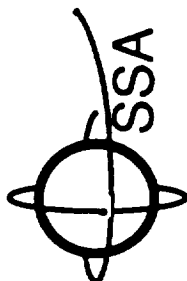
Request for Comments	Internet Documentation Process
Document Series	1) Final documents are RFCs.
<ul style="list-style-type: none"> - Started in 1969 - Now have 1292 1311 - Since RFC 500, all are available on-line - Distribution is primarily via the network (FTP & EMail) 	Available on-line in libraries around the world.
	2) IETF Working groups develop drafts.
	IESG reviews the drafts, makes recommendations.
	LAB approves the drafts for RFC publication.

*RFC - Info Service
RFC-info@isi.edu*

The Internet Cruise

**Laura Kelleher
Merit, Inc.**

**Due to copyright considerations and
changes in the source material, the Internet
Cruise can be acquired from the Merit NIS
at 1-800-66-MERIT**



Requirements Processing Update NSIUWG User Services Subgroup Meeting

April 1, 1992

John H. Martin

NASA Science Internet Office
Information and Communications Systems Division
AMES RESEARCH CENTER



Overview

I. Requirements Processes Overview

II. Future Requirement Process Evolutions

III. Conference Support Update

**JOHN H. MARTIN, MANAGER
PLANNING OFFICE**

CODE	DISCIPLINE	REQUIREMENTS MANAGER	HQ VALIDATOR	ALTERNATE VALIDATOR
S	Office of Space Science and Applications	Maria Gallagher	Dr. Joseph Alexander	Mr. Rick Chappell
SB	Life Sciences	Shelli Jones	Dr. Lawrence Chambers	Dr. Richard (Dick) Keefe
SE	Earth Science and Applications	Regina Duda	Mr. Ernest Lucier	Mr. Dixon Butler
SL	Solar System Exploration	JoAnn Nelson	Mr. Guentler Sirobel	
SM	Flight Systems Division	TBD/John Marlin	Dr. Phillip J. Cressy Jr.	
SN	Microgravity Science and Applications	Maria Gallagher	Mr. Robert Schmitz	Ms. Mary Kicza
SP	Administration and Resource Management Division	TBD/John Marlin	Mr. Scott Santiago	
SS	Space Physics	Maria Gallagher	Dr. James Willett	Mr. Louis Demas
SZ	Astrophysics	Elizabeth Feinler	Dr. Erwin Schmerling	Dr. Guentler Riegler
—	OSSA Conference Support	Hallie Carlson	-----	-----

NSWJ. Martin

as of: 4/8/92

Defining a Requirement

What is a requirement?

A requirement is a scenario of science network usage. They begin as qualitative descriptions by the scientist and evolve into quantitative definitions as a product of working with a Requirements Manager.

Initial Qualitative Description:

"I am a NASA OSSA funded PI. I would like to be able to send mail to Dr. Verducci in Italy, access the Master Directory at GSFC and obtain LRS data from Galileo - can you help me?"

Derived Quantitative Parameters working with Requirements Manager:

Locations - scientists, data

Resources accessed, frequency accessed

Type of computational activity performed across network - (i.e., foreground vs. background and characterize - visualization, "real-time" programming, transaction query, email, file transfer, etc.)

Additional information relating to User Services, Applications, Operations, and/or Security support is also derived.

—► Result: Completed Network Service Request

Planning Office Services

Requirements Planning

***Long Range
Requirements Projection***

***Intradiscipline
Requirements Prioritization***

***Requirements Impact
Analysis/Planning***

***Discipline Level MOU
Development***

***Resource and Systems
Planning***

***Discipline Level Overview of
Req's set with HQ Validator***

Requirements Management

***Project
Requirements Statuses***

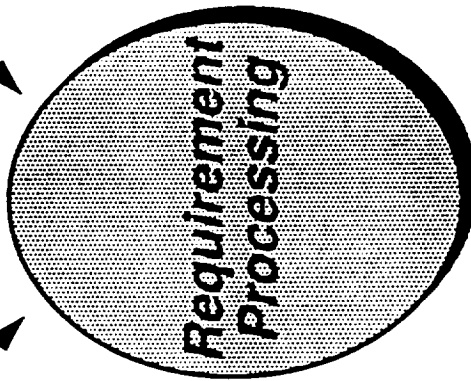
***Manage Requirements
Throughout Process***

***Communications
Requirements Reviews***

***Work with Customer to
Meet Scientific Goals***

***Continual User/PI Customer
Contact and Feedback***

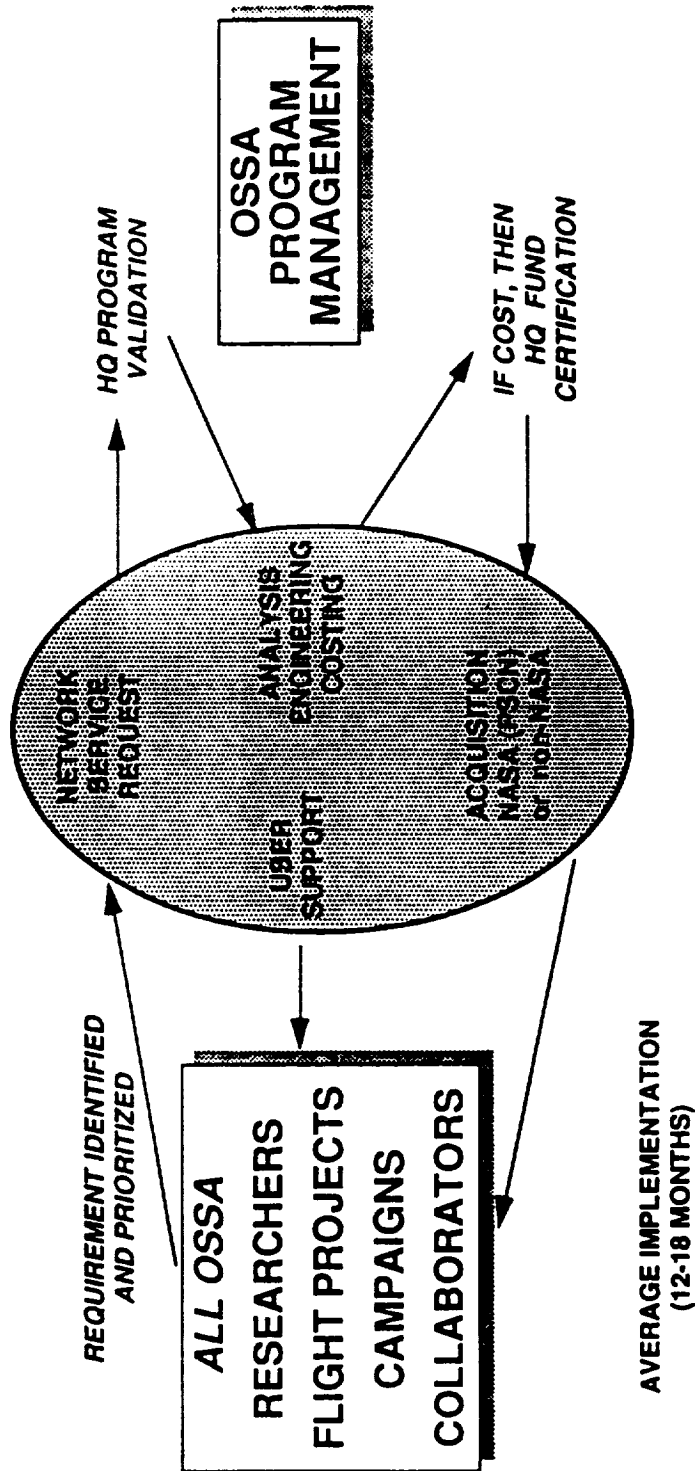
Conference Support/Outreach



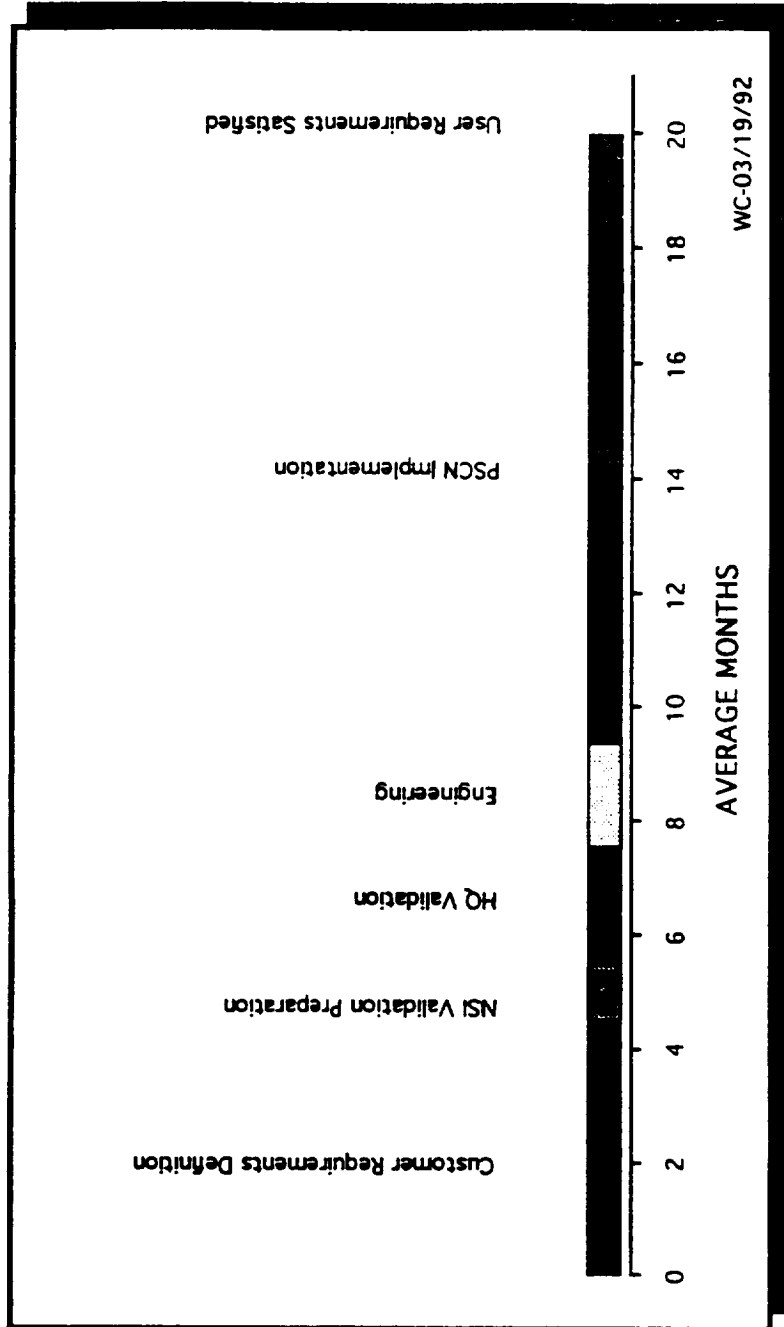
Requirements Processing

*"Coordinating and
assuring requirements
are met"*

NASA SCIENCE INTERNET



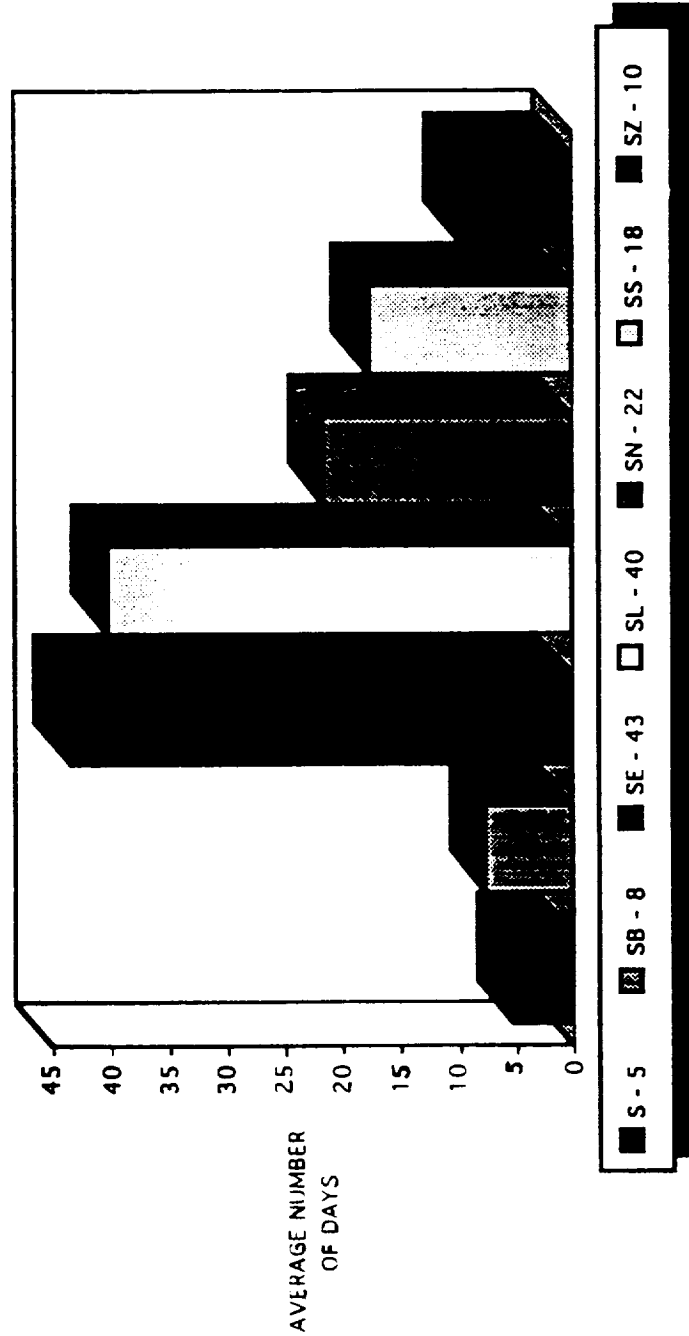
OSSA Requirements Processing Timeline



NASA Science Internet Project

John H. Martin 7

Validation Turnaround Time



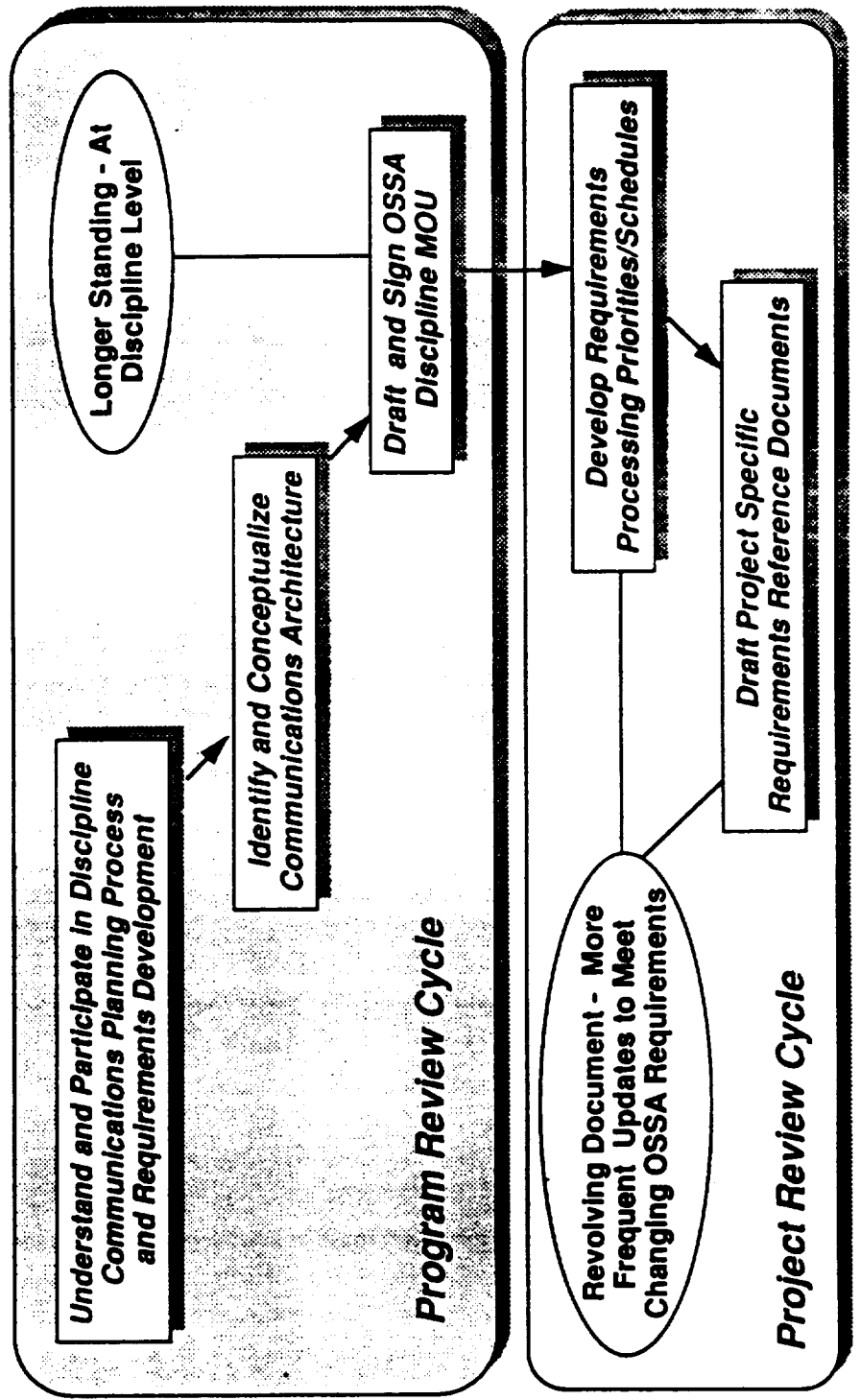
Overview

I. Requirements Processes Overview

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III. Conference Support Update

MOU Development Process



FY 92 Changes

**Refine and Update NSR Process Through NSR Workshop -
Look to Include Cost Weighting, and better hand-offs, QA Measures**

**Look to Increase User Services/NIC Requirements Definition/Tracking
Effort to Incorporate into Existing NSR Process**

Increase Requirements Manager's Outreach to Scientific Community

Redesign MOU Process to Develop Discipline Level MOUs

Step-up Planning Efforts with HQ Disciplines - Schedule Requirements

Hold Communications Requirements Reviews Annually

Standardize Requirements Reporting Format

Overview

I. Requirements Processes Overview

II. Future Process Evolutions

III. Conference Support Update

FY 92 Conference Profile

<u>Conference Supported</u>	<u>QSSA Discipline</u>	<u>Level</u>	<u>Exhibits</u>	<u>Est. Cost*</u>
Division of Planetary Science (DPS) Palo Alto CA.	SL	56kb	PDS	9.4K
American Geophysical Union (AGU) San Francisco, CA.	SE,SS	T1	MD	43.7K
American Astronomical Society (AAS) Winter Atlanta, GA.	SZ	T1	GRO,HESARC, STSci, SAO, IUE,NSSDC, MD, ADC EUVE, IPAC	30.7K
International Space Year (ISY - ESSIS) Pasadena, CA. - JPL	S	(T1)	-----	10.1K
Lunar and Planetary Society Conference (LPSC) Houston, TX. - JSC	SL	(T1)	-----	8.4K
AAS Summer Columbus, OH.	SZ	T1	TBD est.. 5	TBD
American Society of Gravitational and Scientific Biologists (ASGSB)	SB	TBD	TBD	TBD

* = Cost includes NSI internal resources in addition to standard conference charges

NASA Science Internal Project

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Conference Support Updates

**Conference Requirements Managed as "Typical" NSI Requirements
Conference Requirements are Validated, Documented, and Tracked**

**ISMB Direction for Conference Support
Support AAS, AGU, LPSC - Other Conferences Supported According
to NSI Discretion and Available Resources. Funding Assistance
Needed From Society**

**Working with Societies to Ease \$ Impact of NSI Services and to Increase
NSI's Available Resources**

Education of Societies is the Future

NIC On-line System (NONA) Demonstration's Provided

**NSI Comments Email Address Established for User Feedback to NSI
(comments@nsipo.nasa.gov)**

Drafted and Distributed "How to" Documentation

The NASA Science Internet Network Information Center Help Desk

**Bill Yurcik
Hughes STX Corp.**

April 1, 1992

**Presentation to the
NASA Science Internet User Working Group (NSIUWG) Conference**



What is the NSI NIC Help Desk?

**A centralized contact point
to provide/facilitate networking information
for the entire NSI community**

- Respond to user requests**
- Coordinate with the NSI NOC**
- Coordinate with other NICs**
- Reflect user feedback to NSI Project Management**
- Report statistics on Help Desk Operations**



Responding To User Requests

- Sharing information
- Answering questions
- Solving problems
- NSI-DECnet node administration
- Referring users to most appropriate sources
- Internal procedures to optimize our effectiveness
(reference material, training, internal handoffs, organizing information)
- Striving to provide more personal interaction
(increased staff coverage, telephone contact, meetings)



NSI NIC/NOC Coordination

- Coordinate response to user requests with NSI Network Operations Center (NSI NOC)
- Work with the NSI-NOC to provide more network status information to users

e-mail announcements of network events, maps, network statistics, automated voice messages, an automated trouble ticket system accessible to users

- Work with the NSI NOC to provide network management tools to users

a real-time graphical network management system integrating both TCP/IP and DECnet that would be accessible via NSI (read-only)



Reflect User Feedback to Project

- **NSI NIC Help Desk Input to Current NSI Projects**

Reflecting feedback of user-oriented concerns during project development

- **"NSI New User Packet" Contents**

Reflecting feedback from new users who contact the NSI NIC Help Desk in search of "network orientation"

- **Documentation Needs**

Reflecting feedback from users repeatedly requesting similar information either on-line or hard copy

- **NIC Requirements Beyond Scope of Help Desk Operations**

Reflecting feedback from users for large scale user services projects (i.e. NSI Resource Guide, directory services, library access, etc...)



Monthly NSI-NIC Help Desk Report

OBJECTIVES:

- (1) Identification of valuable information to be compiled
- (2) Mechanisms to transparently gather and process NSI NIC Help Desk Information
- (3) Development of significant statistics
- (4) Presentation of statistics in meaningful and visually-intuitive formats
- (5) Mechanisms to distribute a Monthly NSI NIC Help Desk Report to the NSI community



NSI NIC Help Desk Future Objectives

**** WE WOULD LIKE USER PRIORITIZATION INPUT ON THE FOLLOWING ****

- NSI NIC facilitated mailing lists on special interest topics
- An Automated User Request Tracking System
(directly accessible by users via NSI)
- Improved telephone response capabilities
- Increased hours of staff coverage
- Increased reference capabilities, on-line & hard copy
- Increased use of on-line applications in Help Desk support
- NSI NIC Help Desk Newsletter (with FAQ, FYI, news, announcements)
- Training for NSI user community
- Separate NSI User Services Meetings with open discussion

•
•
•



WHO YOU GONNA CALL?

NSI Network Information Center

Code 930.6
Goddard Space Flight Center
Greenbelt, MD 20771

301-286-7251
(FAX) 301-286-5152

nsihelp@nic.nsi.nasa.gov
nsinic::nsihelp



NSI NIC Possibilities

- **Directory Services**

interim solution(s)

- **Indexed Access to the NSI File Cabinet**

NSI ARCHIE client/server

- **NSI NIC Info Server**

based on NNSC info server, automated e-mail responses

- **On-Line Access to NASA Center Libraries**

bibliographic search and retrieval, special databases, nationwide, full text

- **NSI Resource Guide**

one document that pulls together NSI Resources (databases, supercomputers, e-mail syntax, FTP sites, on-line resources, NASA projects, professional groups, etc...)

- **NSI E-mail Distribution Lists on Special Topics**

science_discipline@nic.nasa.gov, project@nic..., net_status@nic..., nsiuwg@nic..., action@nic..., nsi_decnet@nic..., new_tools@nic...



NSI NIC Possibilities

- **NSI Announcement/Bulletin Capability**

info@nic.nsi.nasa.gov, on-line calendar, electronic newsletter

- **Facilitate Research Collaboration on NSINIC Host**

Common development environment for papers, sharing software, electronic journals

- **NSI Information Tools Transfer**

Internet information tools, how to find software tools, network management tools, data transfer tools

- **Assignment of IP Addresses for Nobile NSI Users**

TCP/IP access through configured terminal servers

- **NSI Wide Area Information System (WAIS)**

search and retrieval system which is question-based



NSI NIC Possibilities

**** WE WOULD LIKE USER PRIORITIZATION INPUT ON THE FOLLOWING ****

- NSI NIC facilitated mailing lists on special interest topics
- An Automated User Request Tracking System
(directly accessible by users via NSI)
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- NSI NIC Help Desk Newsletter (with FAQ, FYI, news, announcements)
- Training for NSI user community
- Separate NSI User Services Meetings with open discussion
-
-



Information Tools on the Internet

- ARCHIE** archive server, 2 parts indexer/search, 900 anonymous FTP sites, 1.6 M files, works w/ GOPHER/WAIS/WWW
TELNET archie.sura.net login: archie request 'help'
- GOPHER** hierarchical browsing tool, full text, multi-media, TELNET, FTP, works w/ ARCHIE/WAIS/WWW, TELNET consultant.micro.umn.edu login: gopher
- HYTELNET** menu-based hypertext for finding resources, Unix/VMS/PC anonymous FTP ftp.nut.edu directory library
- KNOWBOT** master directory of directory services info (whois, White pages, X.500, MCImail), model of future automated info gatherer, TELNET nri.reston.va.us 185
- PROSPERO** distributed directories, virtual networked file system, 7,500 systems in 29 countries, works with ARCHIE/GOPHER/WAIS/WWW
send mail to info-prospéro@isi.edu
- WAIS / SWAIS** Query mass store databases, Z39.50 client/server model, results come back with probability, full text, multi-media works with ARCHIE/GOPHER/PROSPERO/WWW, TELNET quake.think.com or hub.nnac.nsf.net login: wais
- WORLD-WIDE WEB** hypertext browsing tool for Unix and Macintosh provides access to full text, multi-media, works w/ ARCHIE/GOPHER/WAIS



Information Tools on the Internet

Library Catalogs:

Internet-Accessible Library Catalogs and Databases

anonymous FTP nic.cerf.net cerfnet/cerfnet_infolibrary_catalog internet-catalogs-mm-yy.txt

Libraries: Accessing On-Line Bibliographic Databases

anonymous FTP ftp.unl.edu library libraries.txt

Libraries: List of Contacts for Internet On-Line Bibliographic Databases

anonymous FTP ftp.unl.edu library libraries.contacts

WUGATE: Gateway to the Internet Libraries and More

U.S. Libraries in 38 states

TELNET wugate.wustl.edu login: library terminal type >> vt100

Campus Wide Information Systems (CWIS)

List of CWIS sites in U.S., U.K., Canada, Germany, Sweden

anonymous FTP ftp.sura.net nic cwis.list



Information Tools on the Internet

On-Line Internet Resource Guides

MERIT

*anonymous FTP nic.merit.edu
directories internet/resources
internet/publications*

NNSC (NSFnet Network Service Center)

*"Internet Resource Guide"
anonymous FTP nnsc.nsf.net
in directory resource-guide
can be received via e-mail using
NNSC Info server by sending a note
to resource-guide-request@nnsc.nsf.net*

NORTHWESTnet

*"Northwestnet User Services Internet
Resource Guide (NUSIRG)"
anonymous FTP ftp.host.nwnet.net
in directory nic/nwnet/user-guide
start with file readme.nusirg*



Information Tools on the Internet

On-Line Internet Resource Guides

NYSERnet

"New User's Guide to Useful and Unique Resources on the Internet"
Version 2.0, anonymous FTP nysernet.org
in directory cd/pubs/guides
also
Menu-driven tour of resources in the guide
allowing transparent access
TELNET nysernet.org login: nyserver
password: nyserver

SURAnet

"Information Available on the Internet:
A Guide to Selected Sources"
anonymous FTP ftp.sura.net
located in directory nlc

THEnet

"User's Directory of Computer Networks"
anonymous FTP emx.utexas.edu
in directory net.directory (87,88,89)



Information Tools on the Internet

Misc Pointers to Information Tools

RFC 120 "There's GOld In Them Thar Networks!"

"Zen and the Art of the Internet: A Beginners Guide to the Internet"
anonymous FTP ftp.cs.widener.edu directory pub/brenden zen-1.0.ps

FTP Anonymous Servers List
anonymous FTP pilot.njin.net directory pub/ftp-list ftp-list

Internet Mail Distribution Lists
"List of Lists"
anonymous FTP ftp.nisc.sri.com directory netInfo interest-groups.txt

NETNEWS



Selected Topics from the Audience

- **Conference Support**
- **Advertising of the NSI NIC**
- **Info server authentication of software**
- **NSI Map, NOC statistics**
- **How to get applications software?**
-
-
-



WHO YOU GONNA CALL?

NSI Network Information Center

**Code 930.6
Goddard Space Flight Center
Greenbelt, MD 20771**

**301-286-7251
(FAX) 301-286-5152**

**nsihelp@nic.nsi.nasa.gov
nsinic::nsihelp**



NSINIC Services Future Possibilities

C. Wrandle Barth
April 1, 1992

HUGHES

HUGHES STX CORPORATION
NSIUWG • March/April 1992

Requirements-Driven Support

HUGHES

HUGHES STX CORPORATION
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- Potential service awareness to feed user requirement process
- Existing basic services
 - Help desk
 - New user documentation and mini-guides
 - Outreach
 - NONA
 - NSI File Cabinet
- Custom services
 - Initially provided to support special requirements
 - May evolve to become a basic service
 - Example: Electronic Postal Facilities
 - Value-added transport-agent services that can be provided on top of traditional email without changing the user agent*

- Remailing
- Address query; with fuzzy match
 - Example: /FN=JOHN*/LN=ROBINSON/INSTITUTION=CUNY
- Distribution lists
 - For official broadcast from few to many
 - For distribution from any to all in group
 - For closed-group discussions
 - For open-membership discussions
- File archive of distributions with ability to order part/all
- Document ordering
 - Email delivery
 - Anonymous FTP/LISTSERV style
 - Abstracts
 - Postal mail delivery
- Trouble ticket status
- Conference registration
- Message text transformation
- Other batch services from NIC

Potential Future Services

- Replicate/customize emerging services (WAIS, Archie, *et al.*)
- Provide utilities for session/presentation/application layers
 - Distributed systems, RPC protocols, client/server systems
 - Interim utilities for data transfer
 - Compression, error checking/correction, library utility, data conversion
- Other OSI/GOSIP applications:
 - MHS/X.400, VT, directory services, transaction processing, remote DB, FTAM, ODA, CGM/GKS, electronic data interchange, SGML
- Educate users in connectivity protocols, software
 - Client/server, among-peer protocols
 - Toolkits for protocol support
- Emerging technologies
 - X³-windows, remote visualization, interoperating databases, multimedia conferencing

CRUSH

The NSI Data Compression Utility

**Edward Seiler
Hughes/STX Corporation
seiler@amarna.gsfc.nasa.gov**

CRUSH

The NSI Data Compression Utility

Features:

- Includes several compression algorithms, providing a choice for particular data sets
- Decompressor automatically chooses correct algorithm
- Automatic mode tests all methods and selects the one that produces the greatest compression
- Compatible with UNIX Compress and DECUS Iz
- Source code written in C, will run on VMS and UNIX machines
- Wildcarded file specifications allowed
- VMS file characteristics (e. g. sequential organization, variable-length records) are retained through the compression/decompression

CRUSH

The NSI Data Compression Utility

Coming soon:

- Algorithms suited especially for compression of images, including the Rice algorithm, and a lossless JPEG variant
- Recognition of FITS formatted data
- Eliminate need to specify UNIX export when compressing VMS files
- Speed improvements

CRUSH

The NSI Data Compression Utility

Compression performance:

- Calgary corpus: includes a bibliography, fiction and non-fiction books, object code, electronic news, technical papers, source code in three programming languages, a terminal session transcript, and a black and white facsimile picture.

Method	Input Bytes	Compressed Bytes	Percent Saved	CPU time (secs)
Best each file	3141622	1216558	61.28%	76.96
LZC	3141622	1259950	59.89%	68.20
ADAP	3141622	1400131	55.43%	215.29
LZRW3A	3141622	1410329	55.10%	52.20
WNC	3141622	1713180	45.46%	186.47

CRUSH

The NSI Data Compression Utility

Compression performance:

- Gray-scale images: A collection of ten gray scale images, including many "standard" images for comparing compression performance, were tested.

Method	Input Bytes	Compressed Bytes	Percent Saved	CPU time (secs)
Best each file	1871648	1097235	41.37%	120.84
ADAP	1871648	1098897	41.28%	118.97
LZC	1871648	1330400	28.91%	32.57
WNC	1871648	1388291	25.82%	100.35
LZRW3A	1478432	1134932	23.23%	16.39

CRUSH

The NSI Data Compression Utility

Compression performance:

- Landsat Thematic Mapper images: Two seven band images of TM data, covering the Washington D.C. and New Orleans, LA areas

Method	Input	Compressed	Percent	CPU time
	Bytes	Bytes	Saved	(secs)
Best each file	3670016	1670823	54.47%	164.88
ADAP	3670016	1670823	54.47%	164.88
LZC	3670016	1971185	46.28%	58.53
WNC	3670016	2159046	41.17%	138.20
LZRW3A	3670016	2578671	29.73%	34.86

CRUSH

The NSI Data Compression Utility

Compression algorithms:

- LZC: the UNIX Compress algorithm, a dictionary-based technique. Good compression with high speed.
- WNC: Witten/Neal/Cleary arithmetic coder with an order-0 model. Good compression for slowly varying source statistics. Moderate speed.
- ADAP: WNC encoding with an order-1 model (symbol pairs). Provides better compression than others for certain data, but is slower.
- LZRW3A: Ziv-Lempel class sliding-window algorithm designed for extremely high speed. Compression comparable to LZC.
- AUTO: tries all algorithms and encodes with the one producing the greatest compression

G. Networking Subgroup Presentations

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**The Program Support
Communication Network (PSCN)**

Program Support Communication Network

What IS: NASA Telecommunication company

- support non-spaceflight critical requirements

Services:

Teleconferencing VOTS
 VITS

Messaging Fax Store/Forward System
 E-mail

Data Dedicated Lines
 X.25
 PSCN Internet

FTS2000 Agent with In NASA

Current Upgrades

- X.25 Packet Switch Upgrade
- Front-End network resource manager NET IDNX 70 & 90's
- Road runner replacement
- DS-3 Ring

DECnet Phase V Update

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Phase V General Strategy

- o Backwards compatibility between Phase V and Phase IV systems during the transition is the cornerstone of the transition plan:
 - Sites needn't do anything for the time being and still will keep existing connectivity. Phase V addressing will follow the existing Phase IV address structure during the transition.
- o The OMNI global namespace will be utilized and supported for the Phase V transition:
 - Sites needn't join OMNI until they bring up their first Phase V system;
 - Sites, however, must join OMNI when they do bring up their first Phase V system.
- o A common Phase IV address structure will be utilized to ensure backwards compatibility during the transition period. The common Phase IV prefix will be 47:0020.
- o DECnet end systems (non-routing nodes) will upgrade to Phase V when they are ready to do so, independent of (sort of...) whether the DECnet area they belong to is still utilizing Phase IV routing, or is utilizing Phase V/CLNS routing:
 - Caveat: As long as the DECnet area is still using Phase IV routing, Phase V systems must be configured to ignore ISO/CLNS routing, or risk having DECnet "break".
- o DECnet areas will be upgraded on an area-by-area basis from Phase IV routing to Phase V/ISO/CLNS routing. The implementation of Phase V routing is complicated by other existing ISO/CLNS support.
- o There will be a limited time frame for the transition period. After that transition period ends, the transition will be declared over, and the requirement for backwards compatibility to Phase IV systems will be dropped. Remaining Phase IV systems will likely suffer from limited access, and have to utilize indirect means (poor man's routing) to access much of the network. Tentative time scale is 2 years from first customer shipment of VMS.

3/30/92



Fermilab OMNI namespace support within ESnet (summary)

- o OMNI will be a global namespace, serving all the DECnet internet community. It will be a distributed namespace with sites wanting to join the namespace assuming responsibility for management of that part of the namespace which directly supports their own node objects.
- o ESnet will join the other networks (NSI-DECnet, E-HEPnet, & E-SPAN) in providing support for the top levels of the namespace that are jointly shared by everyone, and will provide access to the namespace for those sites presently belonging to the ESnet-DECnet network (using ESnet-DECnet area numbers).
- o ESnet facilities will use the following general syntax for logical namespace support:

 US.<facility>.<sub-facility> where <facility>.<sub-facility> mirrors (reverse order) existing internet names at facility level and below.

 US.FNAL.CALVIN (CALVIN.FNAL.GOV) US.ANL.CTD.HOBBS (HOBBS.CTD.ANL.GOV)
- o Two (for now) "master servers" in the ESnet-DECnet, which would be dedicated systems to support inter-site functions for namespace service, containing the following directories:

 <root>, '.US', and generic directories (generic Phase IV node, Backtranslation, DTS)
 Other national ('.CH', '.BR') and agency ('.US.NASA') directories as appropriate.
 Crucial replicas of site-level directories ('.US.FNAL').
- o Synonym directories will be implemented at the site level. Each site will assume responsibility for providing & maintaining its own synonym directory. An information distribution mechanism (similar to existing Phase IV distribution) will be necessary to assist sites in populating their local synonym directory.
- o A generic directory (.US.ESNET.NODE) will be provided to contain the node objects of sites which have not yet joined OMNI. However, once a site joins OMNI, all of its own node objects will be moved from the generic directory to the site directory and be managed by the site.

3/30/92



OMNI namespace support within ESnet (cont.)

- o Sites are required to provide their own name server(s), when they join OMNI. The server(s) will support:

Master replica of site-level directory ('.US.FNAL');
Subdirectory structure below site level directory;
Local synonym table (if desired).

Restrictions & recommendations on site name servers:

At least 2 local name servers is **STRONGLY** recommended;
<root>, 'US', and generic directories will not be replicated on site server(s).
Sites may replicate another facility's site-level directory by mutual agreement.

- o Access control will be managed by the creation of access control groups responsible for maintaining specific directories. The access control groups for the top levels of OMNI are clearly defined; and a model for access control groups at lower levels is specified.
- o Target date for making OMNI available to the ESnet-DECnet community is 5/1/92 (but that seems somewhat optimistic...).



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OMNI status

- o Six countries: US, Italy, CERN, the U.K., France, FRG

- o Two servers in the US:

FNAL (supporting <root>)
MSFC (NASA)

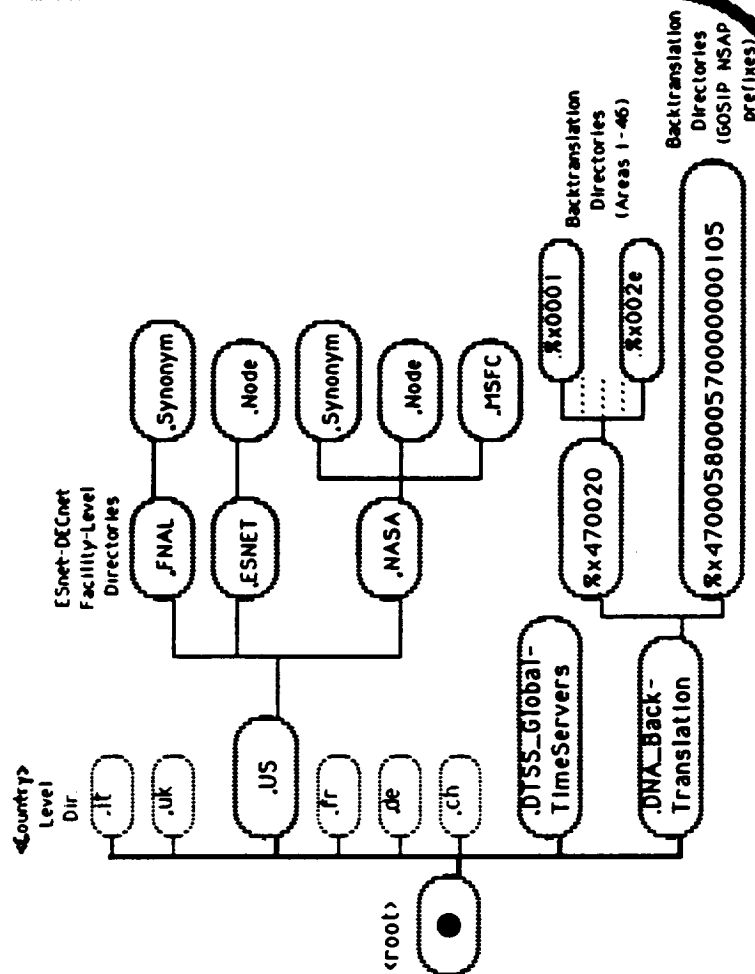
- o One ESnet facility directory:

FNAL (with populated
synonym subdirectory)

- o A generic ESnet directory
(with populated generic
Phase IV node sub-directory)

- o Waiting for:

Server @ LLNL (NRERSC)
to be master server.



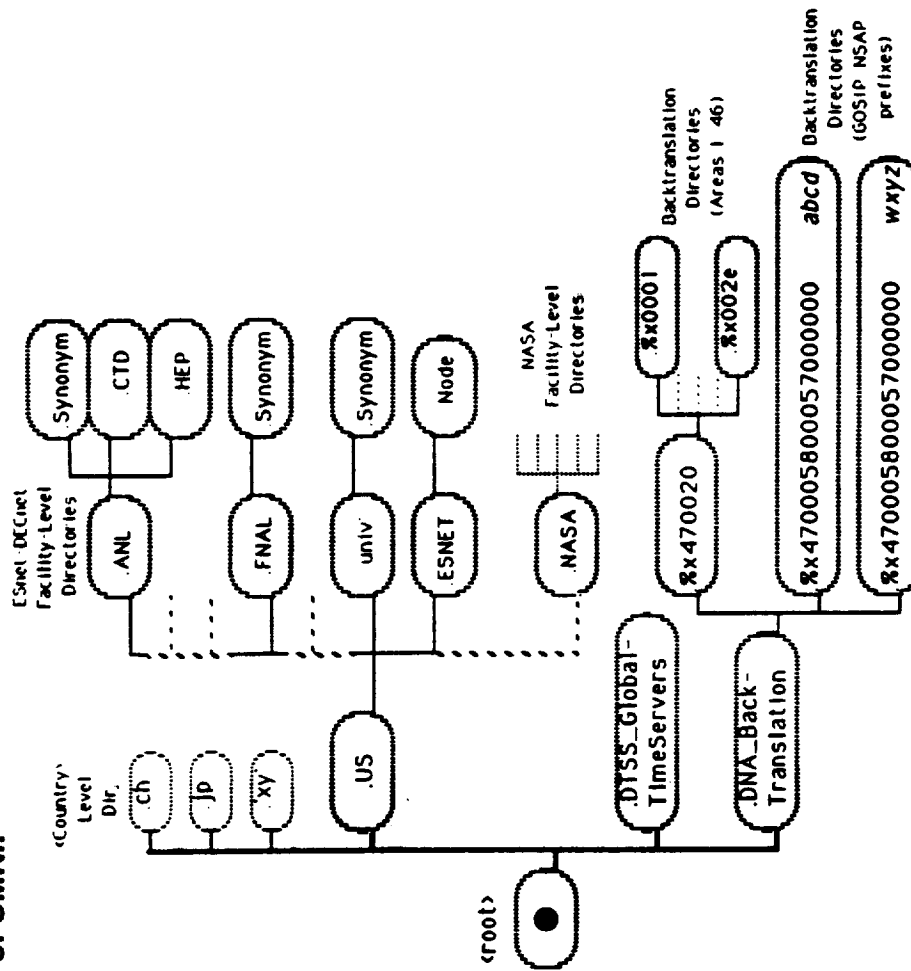
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OMNI status (continued):

- o Ultimate structure of OMNI:



- o All ESnet-DECnet sites (backbone & tail sites) have facility-level directory with synonym subdirectory (and other sub-directory structure, where appropriate).

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Synonyms & Lack of Full Name Support

- o Absence of full name support for VMS means that a hierarchical structured namespace must be administered as a flat namespace.
- o This is technically workable, but at a significant administrative cost:

Synonym table maintenance is the primary means of administering simple name support;

Alternative means of working around the lack of full name support problem include:

 Local root abbreviation for systems with the namespace root;
 Host-based "synonyms" (system logicals);
 VMS has a "limited" (100 nodes) local (host-based) namespace capability, but either the local namespace must be the default namespace, or the namespace name must be specified;
- o All administrative methods of supporting simple names place the burden of that administration down on facility network namespace managers (synonym directory), local system managers (system logicals & local namespace), or the user (use addresses....). The important point is that these entities are no longer just responsible for maintaining their own part of the namespace, but also their view of the entire namespace as well.
- o We plan on assisting with this by setting up an information distribution for ESnet-DECnet synonyms that local sites can use to populate their synonym table. However, naming support beyond the boundaries of the ESnet-DECnet will be questionable (difficult).
- o There is also an architectural concern about allowing users to become dependent on simple name support, creating difficulties dropping the support once full name support is available.
- o The piecemeal support for full names (likely MAIL & SET HOST) does alleviate to some degree the problems with lack of full name support, but does not eliminate the problems/concerns.

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ESnet-DECnet Routing Issues

- o The ESnet-DECnet has a rather complex DECnet routing environment:
 - The ESnet backbone (multiprotocol) is large & heavily interconnected;
 - The ESnet backbone sites tend to share DECnet areas across the backbone;
 - The backbone uses cisco (3rd party) routers;
 - Tail site connections come in many "flavors":
 - Leased lines (both DECnet-only & multiprotocol)
 - NSF regionals (CICnet & Nearnnet)
 - Encapsulation (Multinet)
- o ESnet is already supporting ISO/CLNP:
 - cisco's ISO/IGRP (ie., proprietary) as a routing protocol;
 - A routing architecture with the backbone in its own routing domain (RD) & sites within their own RD (which would fragment a Phase V DECnet area shared across the backbone);
- o An ESnet ISO Routing task force was set up to specify OSI routing across the ESnet backbone that would support a DECnet Phase V transition. The task force has come up with two possible ways of doing that:
 - Special code that would be implemented on one router per site that would "tunnel" Phase V OSI traffic across the backbone, thus joining together the fragmented area.
 - Realign the RD boundaries along existing DECnet Phase IV area boundaries for the transition period.
- o Both options are presently being evaluated for feasibility and impact on the network.
- o Specific routing plans for individual ESnet DECnet areas are on hold awaiting that decision.

3/30/92



ESnet DECnet Phase V Documents

- o ESnet-DECnet Namespace Guidelines - describes the name structure (logical namespace) to be used in the ESnet-DECnet for Phase V:
available via anonymous ftp at NIC.ES.NET decnet/phase-v/dnans_guidelines.txt,
via DECnet at ESNIC::[anonymous.decnet.phase-v]dnans_guidelines.txt
- o ESnet-DECnet Policies and Procedures for Implementation of OMNI Namespace (draft) - describes implementation specifics for joining OMNI:
available via anonymous ftp at HEPNET.FNAL.GOV edwg/omni.ps, or via DECnet at HEPNET::[anonymous.edwg]omni.ps
- o Memo describing current recommendations on installing & configuring DECnet/Ultrix 5.0 (Phase V):
available via anonymous ftp at HEPNET.FNAL.GOV edwg/phasev.ultrix, or via DECnet at HEPNET::[anonymous.edwg]phasev.ultrix

ESNIC = 41.174 / 42158
HEPNET = 42.620 / 43628



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Summary of ESnet-DECnet Phase V Status

- o Namespace planning & implementation are in "final" stages:

ESnet DECdns Policies & Procedures for OMNI Namespace document is in second rev. of draft; the third rev. will likely be passed up to the ESCC for review & approval.

OMNI namespace is in its initial implementation (shakedown) phase with a target date of 5/1/92 for general community access (probably a bit optimistic...).

Lack of full name support on VMS systems makes it unclear when there will be a recommendation for sites to go ahead and bring up Phase V on VMS.

Support for '.EDU', '.GOV', etc. is DEAD & BURIED!

- o Addressing & Routing:

The HSDCG agreed upon Phase IV compatible prefix (47:0020), and the existing Phase IV addresses will be used to create the backwards compatible address structure for the transition period.

There is a recommendation on bringing up Phase V on Ultrix systems, and that is not to do so until OMNI is available. Addressing specifications are included for those wishing to go ahead anyway (caveat emptor...).

Actions pertaining to Phase V routing support remain on hold pending resolution from the OSI routing task force of the Phase V/CLNS routing problem.

3/30/92



NASA/NSI UPDATE DECNET/OSI PHASE V ACTIVITIES

**NSIUWG NETWORK SUBGROUP
APRIL 1, 1992**

April 1, 1992 NSIUWG Network Subgroup

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Phase V Update

New NASA Technical Group (DOT Group)

- DOT meetings - summary
- Current DOT actions
- ICCN

Phase V Testbed Activities

- MSFC/GSFC/DOE

NSI Activities

- DOE/EDWG
- HSDCG

April 1, 1992 NSIUWG Network Subgroup

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Phase V Update

The DECnet to OSI Transition Group (DOT)

- **Met twice - August 21-22, 1991 (Littleton MA) and January 30-31, 1992 (KSC, FL)**
- **Attended by technical reps from most centers, SPAN France and ESA reps, NASA's general wide area network providers (NSI, PSCNI)**
- **Focus of first meeting:**
 - "SURVIVAL TRAINING" - two day intensive bootstrap workshop on the three "ings" - Naming, Addressing, and Routing.**
 - Comprehensive notes and slides available (JUST ASK!)**
 - Results: More meetings...**
- **Focus of second meeting:**
 - DECdns (name service) primarily, then addressing, routing**
 - Dan Anderson (JSC) elected chairman (it was unanimous)**
 - Next meeting at JPL in July**
 - Comprehensive notes and slides available (JUST ASK!)**
 - Results: 1) DECdns service supported by participant centers - will have running in 6-8 months (from Jan)**

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Phase V Update

DOT ACTIONS:

- 1) write "cookbook" on DECdns naming and implementation**
- 2) subgroup to examine RD boundaries in greater detail**
- 3) work with Intercenter Council on Computer Networking (ICCN)**

DOT STATUS:

- 1) cookbook in progress (no draft available)**
- 2) subgroup has yet to meet**
- 3) DOT group now officially recognized subgroup of ICCN**

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Phase V Update

PHASE V TESTBED ACTIVITIES

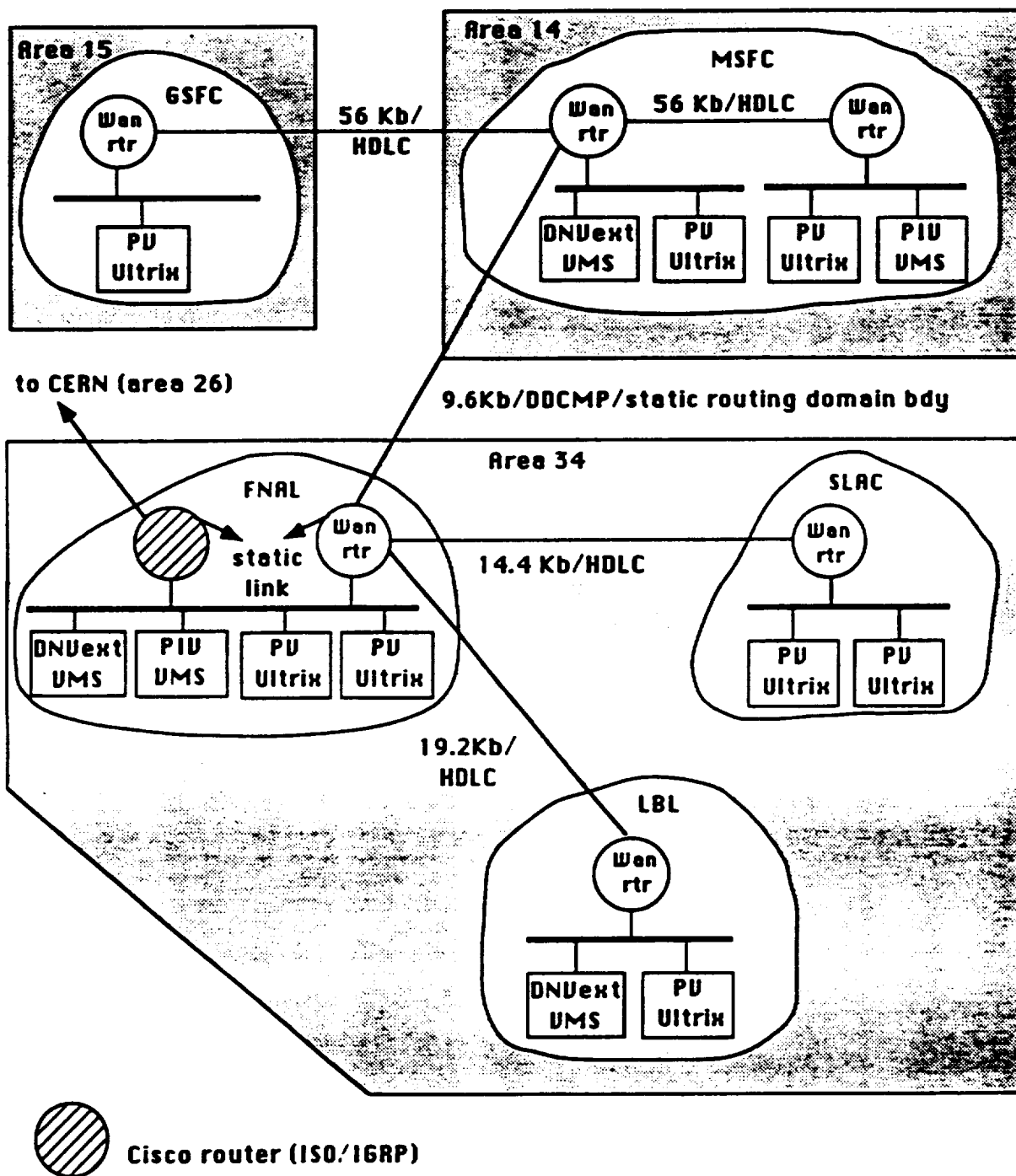
- MSFC/GSFC/Fermi National Accelerator Laboratory (FNAL/DOE) continue Phase V testing (see map)
 - Extensive testing of DECdns, routing on various platforms (Ultrix, VMS, DR2000), Interaction of IS-IS on DR2000 with Cisco CLNP

OTHER ACTIVITIES

- NSI continues collaboration with Energy DECnet Working Group (DECdns naming papers, general PV/OSI transition planning)
 - NASA/NSI DECdns naming paper in draft but available!! (JUST ASK)
 - NASA/DOE transition paper *almost* available (3 weeks - Update from DECUS April 1991 paper)
- NSI continues work with HEP-SPAN DECnet Coordination Group (Warren VanCamp will give summary)

—————> HOW DO YOU WANT NSI/NASA TO INTERACT WITH YOU?

**NASA/DOE OSI/Phase V test network
(snapshot of July, 1991)**



Wanrtr: DEMSA based Phase V router "WANrouter 500"



NSI DECdns Implementation

REQUIREMENTS

LOGICAL NAMESPACE

PHYSICAL NAMESPACE

TIME SERVICES

NSI NAME SERVERS

NSI SITE SERVERS

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NSI DECdns Implementation

REQUIREMENTS

- **Single global namespace for DECnet Internet (called OMNI)**
- **Coordinated time service for name services.**
- **Use X.500 recommendations, hierarchical (tree) name structure.**
- **Efficient access of the namespace by users - i.e. distributed services.**
- **Autonomous management of sub-tree name structure.**

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NASA DECdns Implementation

LOGICAL NAMESPACE

- Relies on X.500 recommendations for full names:

.US.<org>.<org-unit>...

- Recommend names be kept SHALLOW
 - Future requirements may add levels for X.500 or GOSIP compliance.
 - Names are for USERS!
- Recommend adoption of Internet name (if applicable) for DECdns names - minus the "top" level domain (GOV, EDU, etc.). e.g.

SSL.MSFC.NASA.GOV }
MIAMI.RSMAS.MIAMI.EDU } TCP/IP Internet names

becomes (X.500 recommendation DECdns *object*):

.US.NASA.MSFC.SSL }
.US.MIAMI.RSMAS.MIAMI } DECnet Internet PV names



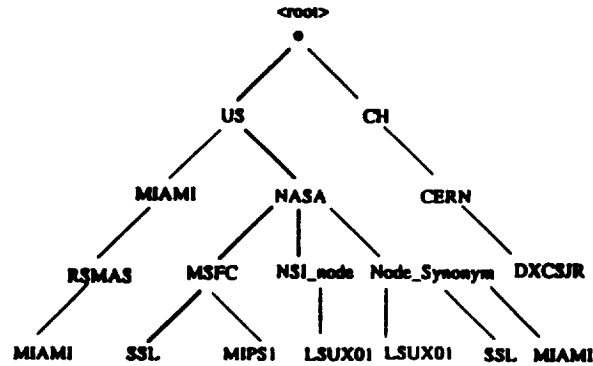
NASA DECdns Implementation

LOGICAL NAMESPACE (Continued)

- Node object directory - contains name, address, tower information for each PIV and PV system in network. Catch-all directory will be created for NSI PIV systems (.US.NASA.NSI_NODE)
- Node synonyms (short names) for NSI systems will be registered in synonym directory for NSI/NASA (.US.NASA.NODE_SYNONYM)
Local site synonym directories may exist. Node synonym directories not shared between major network partners
- Backtranslation directories (for address to name resolution) automatically created by namespace managers and registration process.
- Hierarchical access control groups created for each level of directory structure. Allows small group access to top levels of namespace, centers access and control over own center level directories.
- What does all this look like?...

NSI DECdns Implementation

Logical Namespace Schematic for Names and Node Synonyms



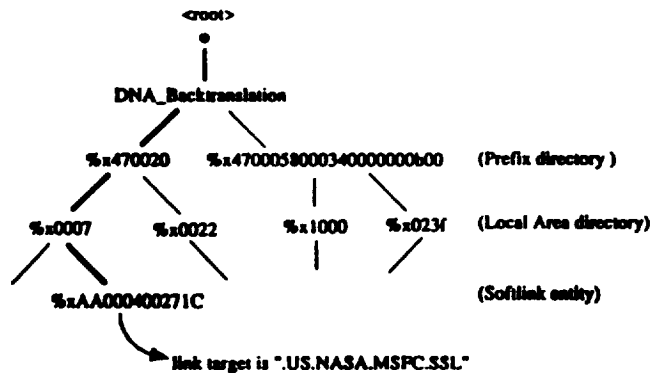
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NSI DECdns Implementation

Logical Namespace Subtree for Backtranslations



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NASA DECdns Implementation

PHYSICAL NAMESPACE

- How the logical namespace structure is distributed over cooperating name servers.
- *Clearinghouses* are files containing one or more *replicas* of directories and their contents.
- Recommend at least two replicas of every directory.
- *NOT* recommended to replicate more than needed.
 - Do *not* replicate on unreliable servers.
 - Do *not* replicate in remote parts of network unless really needed.
- A few servers in global network (Initially 4) will contain replicas of the root ("."), .DNA_Backtranslation, .DTSS_GlobalTimeServers.

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NASA DECdns Implementation

TIME SERVICES (DECdts)

- Used by DECdns to keep namespace consistent.
 - Also provides reliable time information to all DTS clerks on network. (Most systems are clerks)
- Selected DECdts server system objects placed in .DTSS_GlobalTimeServers directory (noncouriers)
- Sites select local systems (couriers) to time off of noncourier systems in .DTSS_GlobalTimeServers directory. Only two per LAN recommended
- DTS clerks (rest of PV systems on LAN) receive timing from couriers on LAN.

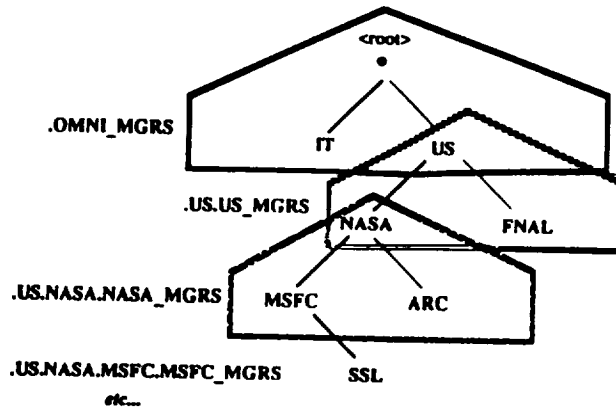
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NSI DECdns Implementation

Logical Namespace Access Control Schematic



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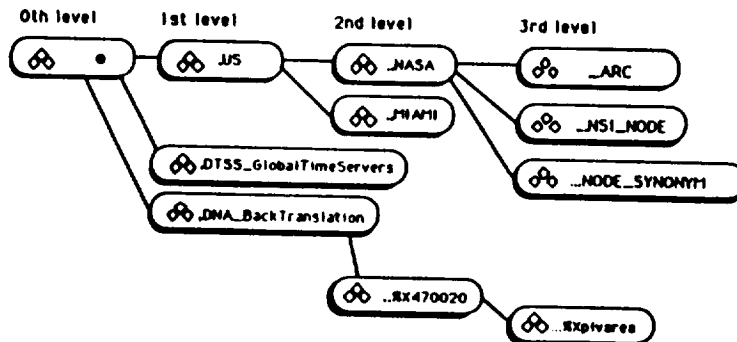
9

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NASA DECdns Implementation

NSI/NASA WIDE NAME SERVERS

- Replicate Important directories:



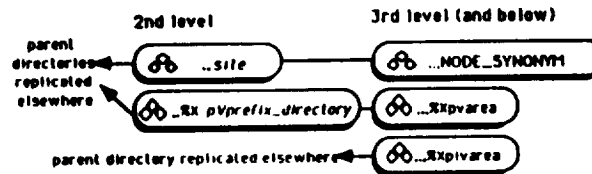
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NSI DECdns Implementation

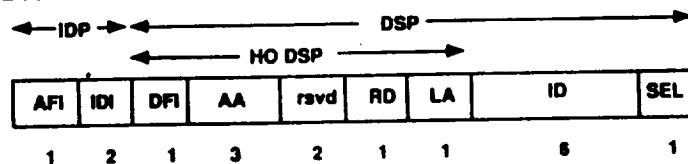
SITE NAME SERVERS:



e.g. "site" could be "MIAMI" (just below .US directory),
Miami uses area 3, "pivarea" would be %X0003.
"pVprefix_directory" and "pVarea" based on OSI style
NSAP (assigned by OSI address authority for U. Miami.)

Addressing

ADDRESSING => GOSIP Compliance for NASA

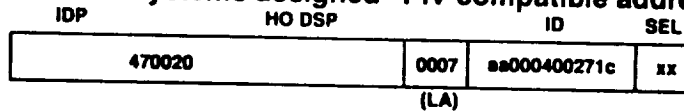


- Two AA's for NASA: 003400 (PSCN) 005900 (NSI)
 - 003400 may be NASA "private"
 - 005900 may be NASA "public" (advertised to Internet)
- Centers may choose to use one or other AA, or may *multihome* to both AAs. (Choice of AA to use does not affect reachability - that is function of routing.)
- Good overview is "Guidelines for OSI NSAP Addressing in the Internet", RFC 1173 by Colella, Gardner, Callon

Addressing

DECnet Phase IV compatibility **REQUIRES**

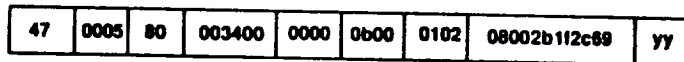
1. All systems reside same IDP+HO DSP (NSAP Prefix)
2. All Phase V systems assigned "PIV compatible address"



- 470020 will be used in DECnet Internet (HSDCG agreement)
- Phase IV address is 7.39 in example for system SSL

If NASA adopts GOSIP, but PIV compatibility requires *non*-GOSIP address (although a valid NSAP), how can transition proceed?

EASY (in theory): Assign system two addresses! (multihoming)
E.g. SSL uses address as above *and* GOSIP Compliant address:



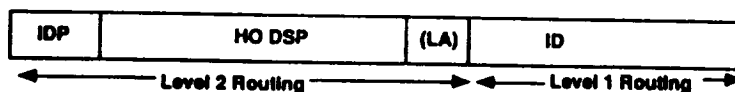
Routing

Intradomain and Interdomain Routing considerations:
Definitions (pertinent routing layer protocols):

- ISO 8473 (CLNP) defines packet format
- ISO 9542 (ES-IS) defines exchange of routing info between End system and intermediate system (a router)
- ISO 10589 (IS-IS) defines exchange of routing info between Intermediate systems *within* a Routing Domain (Intradomain)
- Static Routing: tables used for exchange of routing info between Intermediate systems *between* Routing Domains (Interdomain) IDRP in the future

Above routing protocols depend on CLNP for packet format in ISO.

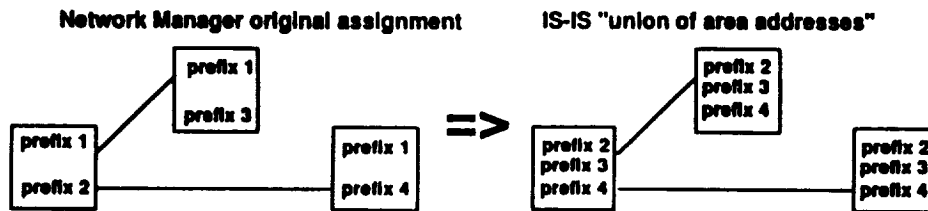
IDP+HO DSP => defines boundary between L1 and L2 routing for IS-IS. (Called "area address") Routing domain boundaries can be set *between* areas, but *not* within an area.



Routing

Intra-Domain Routing (IS-IS)

- Systems may not acquire more than three area addresses (IDP+HO DSP).



This BREAKS PIV/V Compatibility.

Note: IS-IS spec default is three area addresses. Recent spec change raises *maximum* number of areas shared and is based on number of area addresses that will fit in a "link state packet". However, implementations are well behind.

Routing

Inter-domain Routing

- desire to define boundaries beyond which do not wish to share IS-IS (or other Intra-domain routing protocol) information - NOT dependent on value of GOSIP "RD" field!!!
- however, should only be set between IS's with different sets of NSAP address prefixes. THAT IS - cannot set between sites SHARING Phase IV areas (e.g. NASA site hub and University Site).
- Other issues:
- "Two hop problem" - static information is not propagated through an Intervening Routing Domain, therefore if primary path drops, backup path (if exists) will not automatically be used.



- Routing Flood Protection

General Transition Strategy

The "Five Point Plan":

1. Create single namespace for DECnet Internet (OMNI)
2. Specify transition address structure
3. Encourage ES upgrade to PV, using OMNI and address structure
4. Upgrade the routing incrementally
5. Define a timeframe to complete transition

General Transition Strategy

What is "Incremental" routing upgrade?

- Upgrade routing in (DECnet PIV) area one area at a time
Upgrade all PIV L1 routers in area to PV all at once (this is a RULE)
(but still running PIV Level 2)
- Then, can upgrade all PV routers to PV L2 routing. Requires setting Interphase Static Links on area boundaries between areas supporting PV/OSI IS-IS L2 and PIV routing protocols

Issues: Non-DEC routers (Cisco, Wellfleet, Proteon...) and VMS (host-based) routing (excluding cluster alias).

Issues

Goal is to preserve PIV back compatibility during transition.

1. Multihoming limitation restricts which areas may adopt more than one NSAP address.
2. Flexibility required in planning to implement routing domain boundaries during transition.
3. VMS host-based routers, non-DEC routers

Work
in
Progress...

New NASA/SPAN and DOE/ESnet-DECnet Transition Strategy due in three weeks on NSINIC. Look to NSINIC for other interesting (?) docs, too (like Namespace Implementation for NASA's DECdns name servers, version 2.1)

OSI (CLNP) Status

- CLNP (8473) support available on all routers
- IS - IS (DIS 10589) supported on backbone routers
- Static routing to support connections to other AA's

ESnet (005700)
NSFnet (FFFF00)

- RD's available to all NSI sites

GSFC PV/OSI Future

- Allow new (production) systems to come up DECnet/OSI
- First new systems will be Ultrix and brought into GSFCOSI:. NS
- New systems will be running production DECnet-Ultrix V5.0 SW
- Set up a dedicated DECdns nameserver in OMNI that hosts OMNI:.us.nasa.gsfc.
- Depending timing, we may host this on a WS until dedicated platform has been procured

GSFC PV Future (contd)

- Replace WANrouter 500 (DEMSA) w/ DECnis 600
- Bring up OSI CLNP on WAN FW to talk w/WAN OSI networks
- Work w/ concept of bringing up GSFC area 15 to PV/OSI at LII, set up interphase static links to WAN OSI provider, turn off PIV on GSFC FW
- GSFC then routes only OSI (and IP) off campus in WAN

GSFC PV/OSI Experience

- 1 VMS DECnet/OSI system (FT)
- 2 Ultrix DECnet/OSI systems (FT)
- Running FT NS GSFCOSI:. on DS5000/200
- WANrouter 500 (DEMSA platform) 15.1009 running PIV at LI/LII
- FTAM and VTP applications up and running btwn DEC platforms

GSFC Transition to PV/OSI

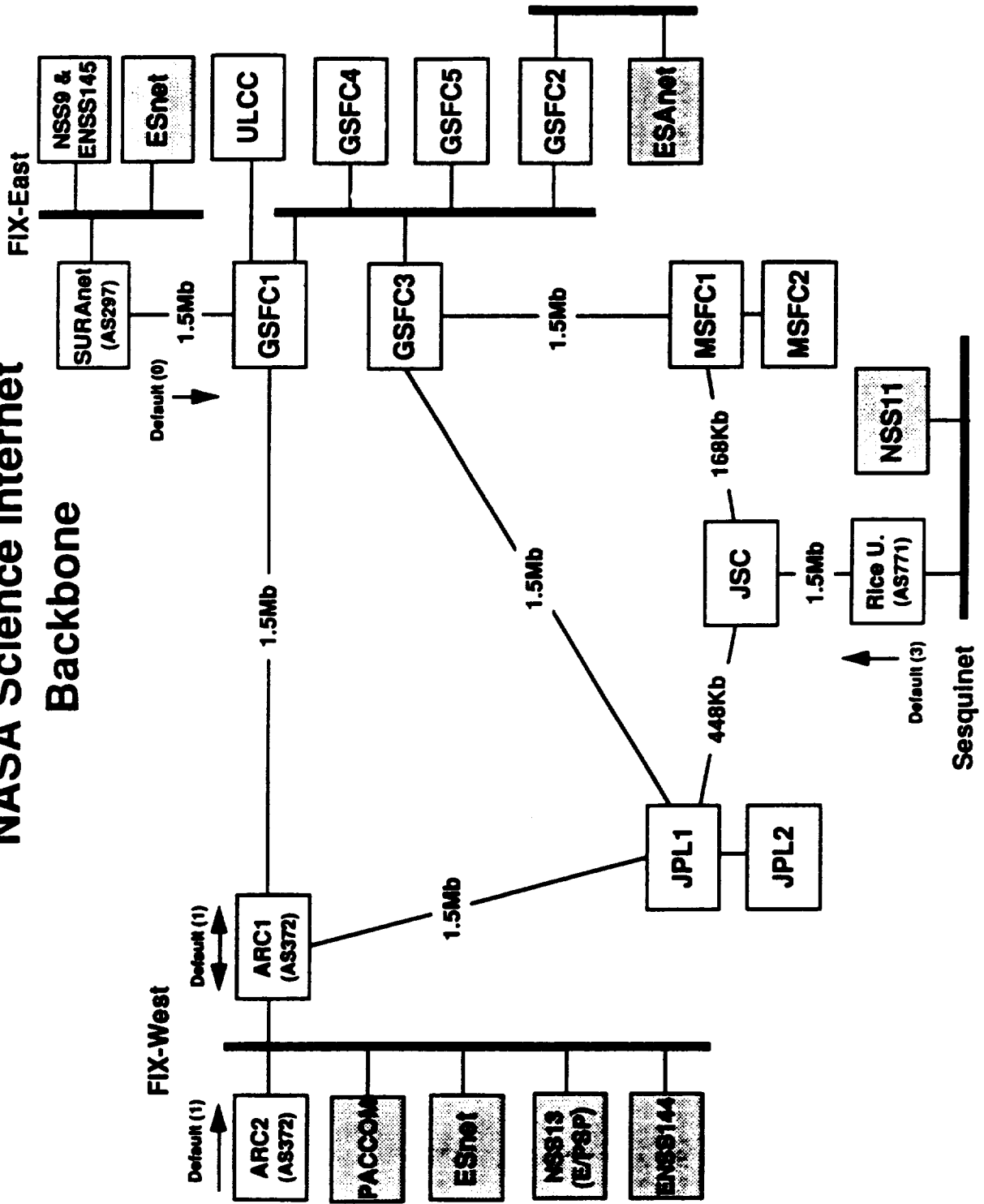
- Migrate all PIV host-based routers to dedicated routing platforms (cluster alias only exception)
- Load all DEC routing platforms w/ WANrouter SW
- Run WANrouters at PIV LI /LI routing alorithms
- Non-DEC routers capable of IS-IS (or integrated IS-IS)?
- Check interoperability of NON-DEC and DEC WAN routers

GSFC Transition to PV/OSI (contd)

- Interoperability check above area 46 or extended address ?
- Cut-over to PV/OSI Link-State routing at LI (DECnet area 15)

NASA Science Internet Technical Update

NASA Science Internet Backbone



NSI End Sites

AGU and AAS Headquarters	56	IP
Advanced Rotorcraft Technology	56	DMP
Aerospace Corp.	56	DMP
Air Force Geophysics Lab	56	DMP
Arizona State	56	D*
Augsburg College	9.6	D
Big Bear Solar Observatory	56	DMP
Boston Univ.	9.6	D
Brown Univ.	(56)	D
Capitol Gallery-East	1536	DMP
Carnel Research Center	56	DMP
Carnegie Institute of Washington	56	DMP
Center for Aero. and Scientific Information	56	IP
Centre College	56	DMP
Citadel College	56	IP
CoBE Offsite Facility	1536	DMP
College of Charleston	56	IP
Comsat Labs	56	IP
Cornell Univ.	56	D*
Dartmouth	9.6	D

NSI End Sites (cont.)

Dryden Flight Research Facility	1536	D/P
Ellery Systems, Inc.	56	IP
Eloret Institute	56	IP
Florida State	9.6	D
Gilmore Creek Geophysical Observatory	56	IP
Government Systems, Inc.	1536	IP
Grumman Aerospace	9.6	D
Hamden-Sydney College	56	IP
Harding Univ.	56	IP
IUE, Computer Sciences Corp., Greentec	1536	D/P
Johns Hopkins Univ., Applied Physics Lab	56	D
Kennedy Space Center	56	D/P
Langley Research Center	1536	D/P
Lewis Research Center	168	IP
Lockheed, Palo Alto Research Center	1536	D/P
Loral, ST-DADS	56	D/P
Louisiana State	56	D
Lowell Observatory	56	D/P
Lunar and Planetary Institute	1536	D/P
MIT	9.6	D

->448
->1008

NSI End Sites (cont.)

Maine International Airport	56	IP	
Mojave Base Station	56	IP	
NOAA, NIST/Space Environment Lab	56	D/IP	->1536
NOAA, NODC	9.6	D	
NOAA, Sulland Professional Center	56	D	
NOAA, World Weather Building	1536	IP	
National Center for Atmospheric Research (NCAR)	1536	D/IP	
National Geodetic Survey	56	IP	->1536
National Radio Astronomical Observatory	(56)	D	
Naval Postgraduate School	9.6	D	->(56)
Naval Research Lab	56	D*	
New Mexico Highlands Univ.	56	IP	
Northwest Research Associates	56	D/IP	
Northwestern State, Louisiana	56	D/IP	
Oregon State	56	D*	
Owens Valley Radio Observatory	19.2	D/IP	
Penn State	56	D*	
Planetary Science Institute	56	D/IP	
Rand Corp.	(56)	D	
Rice Univ.	1536	D/IP	

NSI End Sites (cont.)

Richmond Station	56	IP
STX, ST Systems Corp.	1536	D/P
SURAnet, FIX-East	1536	D/P
SDSC, Scripps Institute	56	D
Service Argos, Inc.	56	D/P
Silicon Engines, Inc.	56	IP
Smithsonian Astrophysical Observatory	1536	D/P
Southwest Research Institute	56	D/P
Space Telescope Science Institute	1536	D/P
Stanford Univ.	(56)	D
Stennis Space Center, NORDA	56	D/P
TRW Corp.	56	D
U.S. Naval Observatory	56	D/P
UCLA	56	D
USGS, EROS	9.6	D
USGS, Flagstaff	56	D/P
USGS, Menlo Park	(56)	D
USGS, Repton	9.6	D
USRA, Huntsville	9.6	D
USRA, Washington, D.C.	56	IP

->1536 D/P

NSI End Sites (cont.)

Univ. of Alabama, Huntsville	56	D	->1536 D/P
Univ. of Alaska, Geophysical Inst. & SAR Facility	56	D/P	->1120
Univ. of Arizona	1536	D/P	
Univ. of California, Berkeley (SSL)	(56)	D	
Univ. of Chicago	56	D	
Univ. of Colorado, Boulder	56	D	
Univ. of Delaware, Bartol	(56)	D	
Univ. of Delaware, Lewes	(56)	D	
Univ. of Iowa	224	D	
Univ. of Kansas	56	D*	
Univ. of Maryland	9.6	D	
Univ. of Maryland, SAMPEX	(56)	D	
Univ. of Miami	1536	D/P	
Univ. of Miami, ATS	9.6	D	
Univ. of Michigan	56	D*	
Univ. of Minnesota	56	D*	
Univ. of Montana	56	IP	
Univ. of New Hampshire	9.6	D	
Univ. of Rhode Island	56	D*	
Univ. of South Florida	56	D*	

Network Engineering

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NSI End Sites (cont.)

Univ. of Southern California (USC)	(56)	D
Univ. of Tennessee, Space Institute	56	IP
Univ. of Texas, Austin	56	D
Univ. of Washington	(56)	D
Univ. of Wisconsin	9.6	D*
Utah State	(56)	D
Vexcel Corp.	56	IP
Wallops Flight Research Facility	448	D/JP
Washington Univ., St. Louis	9.6	D
Woods Hole Oceanographic Institute	9.6	D
Yale Univ.	9.6	D

NSI International Connections

Cerro Tololo Inter-American Obs., Chile	56	IP
European Space Agency, ESOC	256	D/IP
European Space Agency, ESTEC	576	D/IP
ISAS, Japan	56	D
Inst. for Space & Terr. Science, Canada	9.6	IP
McMurdo Station, Antarctica	56	IP
National Research Council, Canada	9.6	D
Oxford Univ., UK	128	IP
Rutherford Appleton Lab, UK	64	D/IP
Sondrestrom Radar Facility, Greenland	56	IP
Univ. of London, UK	128	D/IP ->512

NSI International (PACCOM)

NSI operates circuits for PACCOM which connect at FIX-West (ARC) to other networks

Univ. of Hawaii	1536	D/IP
Chinese Univ. of Hong Kong	64	IP
Inst. for Supercomputer Research, Japan	64	IP
Univ. of Melbourne, Australia (AARNET)	512	IP
Univ. of Waikato, New Zealand	64	IP

ncfrt3:	JPLRT8	THOR	6.636					
ncfrt4:								
ncfrt5:	MORRIS	JSCRT1	ESOCR1	SIPVAX				
ncfrt6:	6.151	6.143	6.215	6.180	6.221	6.145	6.510	
ncfrt7:	11.214	6.682	6.250	6.610	6.721	6.400	6.216	18.170
bypass:	CRCVAX	PGGIPL	BARTOL	DELOCH				
	SERIAL-1	SERIAL-2	SERIAL-3	SERIAL-4	SERIAL-5	SERIAL-6	SERIAL-7	SERIAL-8
lasele:	7.124	3.26	7.851	7.189				
feilix :	7.115	7.20	7.160	7.230				
morris:	5.68	9.171	6.1021	7.38				
kscrtr:	LASSIE	7.649						
jscrtr1:	MORRIS	NCFRT5	JPLRT8	UTSPAN				
jscrtr2:	UCERT1	ACIDURS	ESSDP1					
jscrtr3:	RICE	SELVAX	SWRI					
jplrt2:			HYRAX		PSIKEY			
jplrt5:		5.256		5.298				
jplrt6:	5.520		5.500	5.237				
jplrt7:		5.764	27.930	33.379				
jplrt8:	9.171	7.600	6.140					
jplng :	CYCLOP	IAGO	ASTRON					
ncap24:	ISDMNL	UCBSP	UMSPAN	STAR			USU	
arcrt6:	ISAS	ART	ISAS					



Network Engineering

WVanCamp 2

Introduction

HSDCG meeting held in Bologna, Italy, 19-20 September 1991:

NSI-DECnet

ESnet-DECnet

E-SPAN

E-HEPnet

also represented:

Japan (HEPnet-J and TISN)

Digital Equipment Corp

Meeting included status updates from the networks

Meeting focus was on DECnet Phase V issues

Addressing

Routing

Naming (primary meeting focus)

Addressing

Phase IV address prefix has been donated to the global DECnet by CERN and use has been agreed on by HEP/SPAN

prefix = 47:0020: (areas 00-00 to 00-FF only)

Phase V systems will also multi-home to GOSIP addresses in the U.S. (other countries have other requirements)

The size of GOSIP NSAP addresses may affect the number of different areas that can be supported by multi-homing

Routing

HEP/SPAN expects static routing domain boundaries will be setup between the different networks:

NSI-DECnet

ESnet-DECnet

European SPAN

European HEPNET

Where multiple "shareable" HEP DECnet lines go from Europe to the U.S., they will be put into a single routing domain so that automatic backup can occur

Routing will be planned for and implemented on an area-by-area basis

Routing plans for the U.S. networks will be developed further as software becomes available from other router vendors

Naming

Naming was the primary focus of the HSDCG meeting, since DEC is now distributing DECnet Phase V software on ULTRIX, which requires the use of DECdns naming

All of the networks want to share a single global namespace to ensure that systems can talk to each other

Preliminary design and review of this namespace, called "OMNI", was performed at the meeting

DECdns provides the necessary services for the namespace

Naming scheme is to be based on X.500 and Internet names (but there are issues still unresolved in the U.S.)

Naming Logical Structure

The general name structure follows the form:

.country.org.org-unit.org-unit...object

where:

. = <root>

country = 2 letter ISO country code (e.g., US)

org = organization name (e.g., NASA)

org-unit = site name (e.g., GSFC)

object = namespace object, such as a nodename

An example node:

.US.NASA.GSFC.DFTNIC

The "OMNI" Structure

root	country	org	org-unit
------	---------	-----	----------

<root>			
	.US		
		.NASA	
			.ARC (etc.)
			.Node_synonym
			.NASA_MORS
			.NSI_Node
			.NASA1_CLH
		.LBL	
		.LLNL	
		.US_MORS	
		.OMNI_MORS	
		.OMNI_CLH	
		.DTSS_GlobalTimeServers	
		.DNA_BackTranslation	
		.XX470020	
		.XX4700058000590000000001	
		.UK	
		.IT	
		(other countries, etc.)	

The "OMNI" <root>

<root> Directory

4 Replicas (2 in U.S., 2 in Europe)

Supported on systems dedicated for nameservice

Contains clearinghouse objects of clearinghouses that replicate the <root>

Common global directories

DNA_BackTranslation (and %X470020 subdirectory)

DTSS_GlobalTimeServer

NQ! DNA_Node

NQ! DNA_NodeSynonym

Common global directories are replicated on the same servers which support <root>

Country-level Directories

Approved by HSDCG and implemented by <root> admin group

Utilize ISO two letter country code

Country-level server contains:

- country directory (master replica)
- backtranslation area directories in that country (master)
- organization directories (R/O replicas)

A country-level admin group must be defined to provide access and management control

Org-level Directories

Implemented by country admin groups

Org-level server contains:

- org directory (master replica)
- site directories (R/O replicas)
- site directory (master replica, possibly)

The org-level directory contains the clearinghouse object for the org-level server (e.g., .US.NASA.NASA1_CLH) unless it is already contained in the <root>

An org-level admin group must be defined to provide access and management control to all directory levels below "org"

Namespace Access

Access to the <root> will be strictly controlled and requires the agreement of the HSDCG representatives

Access to country-level directories and servers is explicitly left as a national decision to country admin groups

It is recommended that after a directory is created, the creator continues to have write access to the directory (but no lower-level directories). In order to help troubleshoot any namespace problems (e.g., after US_MGRS creates .US.NASA in the .US directory, it would continue to have write access to .US.NASA, even though NASA_MGRS would be maintaining the master replica

Phase IV Synonym Table

The Phase IV synonym table provides a method for a Phase IV application to map a 6 character nodename into a fully specified DECdns name

There are currently conflicts between the different networks for many of the nodenames (e.g., CALVIN), which would have to be resolved to share a single synonym table

Instead, each network will provide synonym table(s) for their own network, and together develop a mechanism for merging other network synonym tables

NSI-DECnet will provide a single, NSI-wide synonym table, but sites (on a per-system basis) can redefine their own synonym table location if required

Namespace Recommendations

<root> and country-level nameservers must use DECdns version 2.0 or later

Each site should provide a master replica and at least one additional replica of its directories

The additional site replica can also be provided by another site, or by prior arrangement on one of the master servers

DECdts Time Service

DECdts time service is required for DECdns name service
Time service is used to ensure that DECdns name service
updates are synchronized throughout the global network
The number and location of "global" time servers will be
coordinated by the HSDCG to ensure a reliable distribution
throughout the network

Current NSI Plans

Procure two "master" dedicated DECstation nameservers, to support:

- one replica of <root>
- one (or both) will contain replicas of .US
- both will contain replicas of .US.NASA (one is master)

Servers will also:

provide DECdts time sources

provide (optionally) backup replicas of site directories

Evaluate procurement of additional servers as required

NASA's DECdns Nameserver

**A current version of this text is available in
PostScript format from the NSI File Cabinet as:**

NASA_DECdns_IMPLEMENTATION.PS

in the directory:

[ANONYMOUS.FILES.PROTOCOLS.DECNET.PHASE_V]

H. Tutorials

Vision for the NSI Online Network Aide (NONA)

**Brian Lev
Hughes STX Corp.**

April 2, 1992

**Presentation to the
NASA Science Internet User Working Group Conference**



The NSI Online Network Aide (NONA) Why Build It?

- Experience had proven that an on-line system increased the number of users who could be helped in any given period of time without over-taxing human staff.
- Rapid response needed to official assignment of NIC duties to staff at GSFC, but immediate hiring of additional staff to handle extended workload was not possible.
- Two systems already in use at GSFC for network user support (SPAN-NIC and NICOLAS) were available to serve as testbeds for NSI information and services.
- Porting of an existing system would allow near-immediate response to the increased workload.



The NSI Online Network Aide (NONA) The First Build

- **NICOLAS chosen as "template" system**
 - required no new purchases, licensing, or staff training
 - guaranteed to work on existing platform(s)
- **DFTNIC VAX 3250 chosen as host**
 - wide variety of network links and protocols
 - already hosting NICOLAS
 - already managed by NSI USO staff
 - bypassed wait for new NSI-purchased hardware to arrive
- **Emphasis on rapid installation to fill gap in user services.**
- **Small-scale NICOLAS "clone" with emphasis placed on NSI, as opposed to GSFC-specific, information.**
- **Relatively basic information server, relying heavily on NICOLAS and the old SPAN-NIC to fill gaps in content and connectivity.**
- **Recorded just over 900 user sessions in one year.**



The NSI Online Network Aide (NONA) Background of Current Version

- **Version 2 beta installed on NSINIC MicroVAX 3300 after completion of hardware's acceptance testing.**
- **Fully functional "pilot" system opened for use by the NSI community in time for the December, 1991 AAS Conference.**
- **Recorded roughly 100 user sessions in its first month of operation; usage grew to 480 sessions in January, 1992.**
- **Over 740 user sessions recorded in February 1992.**
- **First phase of operational testing now considered as completed successfully; system now ready for additions to become true Version 2 of NONA.**
 - The old version running on DFTNIC was taken off-line for the last time on February 10, 1992.



The NSI Online Network Aide (NONA) Changes from First Version

- Now running on a newer, faster host dedicated only to NSI support.
- Uses improved driver software for faster response to user input.
- Features user tracking that is both more comprehensive and more transparent.
- Driver modifications allow simpler formatting of text files.
- User messages & problem reports now routed directly into the NIC's Help Desk Email.



The NSI Online Network Aide (NONA) What We Offer Now (Version 2 beta)

- "Hot News" about NONA, the NSI, or other items of importance.
- Instructions on using NONA.
- Info About the NSI and Other Nets
 - What Is the NSI?
 - NSI Program Objectives and Management
 - Acquiring NSI Connectivity
 - Info about the Internet and other nets (BITNET, THENet, USENET, etc.)
- NSI Personnel for Additional Help
 - How to contact the NIC and NOC
 - Points of contact at individual NASA and ESA centers
- Help Files and Info
 - Automated Email matrix and dictionary of networking terms & NASA acronyms
 - Information & instructions for the NSI File Cabinet
- Problem Reporting/Message Box Mechanism
 - Sends flagged Email messages to the NSIHELP account and notifies NSI USO staff
- Transparent "Quick Connects" to SPAN-NIC & NICOLAS



The NSI Online Network Aide (NONA) What We Offer Now (Version 2 beta)

HOW IT WORKS

- **Menu-Driven Navigation**
 - simply choose desired option by number
 - plain English instructions for all steps
 - help for each menu available with "H" or "?"
- **Can Leave At Any Time**
 - from any menu, Q (quit) or X (exit) will log you out
 - when reading files, Q or X return you to the menu you came from
- **Forgiving Environment**
 - plain English error messages
 - available commands always on screen
 - can scroll text backwards one screen at a time
 - can refresh text displays with "R"
 - designed for VT100 "lowest common denominator"
 - designed to "fail gracefully" in worst-case scenario



The NSI Online Network Aide (NONA) The Next Step: From "2 beta" to "Version 2.0"

- **More & Better Information About NSI, such as:**
 - Improved description of levels of service and usage guidelines
 - New information about USO, OPS, ENG, and SNP groups
 - All current information updated (e.g., project charter & organization, staff, etc.)
 - Better description of how NSI differs from "The Internet"
- **More User Options, such as:**
 - White Pages interface
 - Transparent access to specific on-line resources (e.g., NSI File Cabinet, OMNET's "Lists", PI-NET, etc.)
 - Addition of NICOLAS' wide-area functions (whois, finger, nslookup, BITNET lookups)
- **Inclusion of SPAN_NIC Data Base**
 - Completes inclusion of all SPAN_NIC offerings
 - Old system will be taken off-line when done
- **More Information About Other Networks**



The NSI Online Network Aide (NONA) The Next Step: From "2 beta" to "Version 2.0"

What You've Said So Far...

- So far, responses on the "NONA Futures" questionnaire, items in the NONA message box, and general Email indicate that the NSI user community wants further emphasis placed on:
 - expansion of the Email matrix
 - more information about other networks
 - more up-to-date NSI information
 - wide-area lookup functions (whois, finger, et al.)
 - direct access to contents of the NSI File Cabinet



The NSI Online Network Aide (NONA) Future Growth: Steps Along the Way

- Growth of NONA will be based on user requirements
- Possible Additions, 6 Month Timeframe:
 - New complete "branches" of SNP and NOC information (contacts, charter, offerings, etc.)
 - User registration for personalized interaction
 - NSR and RFS status
 - Expansion of Email matrix
- Possible Additions, 12 Month Timeframe:
 - New "forum" or Q&A segments à la "Ask Harry"
 - Ability for users to request specific information files for delivery
 - Add ARCHIE interface
 - Add USR and Trouble Ticket status
 - Full interactive access to NSI File Cabinet
 - Improved ties to other on-line resources (e.g., ALEX)
- Possible Future Additions
 - Map of current NSI link status
 - Continual improvement of ties to other on-line systems
 - Real-time delivery of requested files



The NSI Online Network Aide (NONA)

Our Overall Goal: "Systemus Maximus"

- The following user-oriented capabilities are all considered part of an "ultimate" system:
 - Serves as "universal interface" for NSI on-line offerings (e.g., White and Yellow Pages, ALEX, etc.)
 - recognizes and reproduces user's environment (X windows, text only, etc.)
 - offers both "power user" (command line) and menu-driven interfaces
 - provides for real-time contact with human operator
 - provides a "guided tour" of itself
 - registers users to personalize interaction and build contact data base
 - utilizes "knowbot" or other Expert System/Artificial Intelligence approaches to help anticipate users' needs while easing access to information
 - allows users to browse contents of the NSI File Cabinet
 - provides on-demand delivery (via appropriate method) of all documents and information available on-line
 - utilizes graphical displays where possible
 - utilizes multimedia mail (voice, video, and text) for user-to-staff contacts in real time



How Do I Get to NONA?

via TCPIP: telnet nsinic.gsfc.nasa.gov
Username: NSINIC

via DECnet: SET HOST NSINIC
Username: NSINIC



WHO YOU GONNA CALL?

NSI Network Information Center

**Code 930.6
Goddard Space Flight Center
Greenbelt, MD 20771**

**301-286-7251
(FAX) 301-286-5152**

**nsihelp@nic.nsi.nasa.gov
nsinic::nsihelp**



The NSI Online Network Aide (NONA) Selected Foreign User Sites, 1992

Ben Gurion University, Be'er Sheva, ISRAEL
DFVLR Oberpfaffenhofen, Weßling, GERMANY
Danish Computer Centre for Research and Education, Lyngby, DENMARK
ESA Villafranca Satellite Tracking Station, Madrid, SPAIN
ESA-ESRIN, Rome, ITALY
Eindhoven University of Technology, Eindhoven, HOLLAND
Institut d'Astrophysique de Paris, Paris, FRANCE
Japan INET, Kyoto, JAPAN
Korea Advanced Institute of Science and Technology, Seoul, KOREA
Max Planck Institut fuer Kernphysik, Heidelberg, GERMANY
Max Planck Institut fuer Plasmaphysik, Garching, GERMANY
McGill University, Toronto, Ontario, CANADA
Observatoire de Paris-Meudon, Meudon, FRANCE
Rutherford Appleton Laboratory, Chilton-Didcot, ENGLAND
Technion University, Haifa, ISRAEL
Tel Aviv University, Tel Aviv, ISRAEL
Universidad Nacional Autonoma de Mexico, Ciudad de Mexico, MEXICO
University Brunswick, Braunschweig, GERMANY
University of Alberta, Edmonton, Alberta, CANADA
University of New Brunswick, Saint John, New Brunswick, CANADA
University of Saskatchewan, Saskatoon, Saskatchewan, CANADA
University of Tübingen, Tübingen, GERMANY
University of Waterloo, Waterloo, Ontario, CANADA
York University, North York, Ontario, CANADA



Tutorial on X.500 and QUIPU

Peter Yee
Ames Research Center

April 2, 1992

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Audience

- Participants in the NASA X.500 White Pages Pilot
- Want - to - participants
- Hardcore X.500 junkies

If you are not one of the above, this may be boring!

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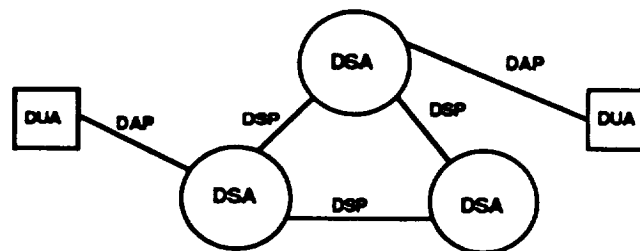
The Directory: What is X.500

- A (potentially global) distributed database.
- Optimized for data searching and listing.
- Not necessarily as consistent as a true database system.
- An international standard for provisioning of directory services.
- A floor wax and dessert toppings, all in one!

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X.500 Model



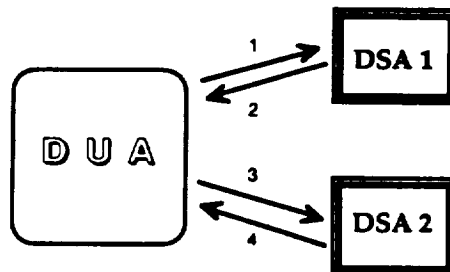
DSA Directory System Agent
DUA Directory User Agent
DAP Directory Access Protocol
DSP Directory System Protocol

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X.500 Access

Referrals



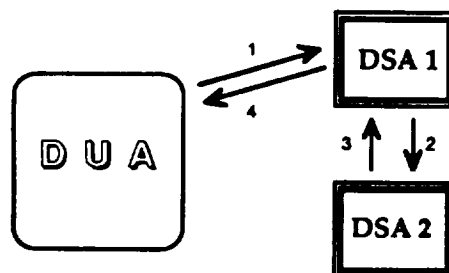
Only when DUA can connect to both DSAs (network topology or protocol problems may prevent this).

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Information and Communications Systems Division

X.500 Access

Chaining



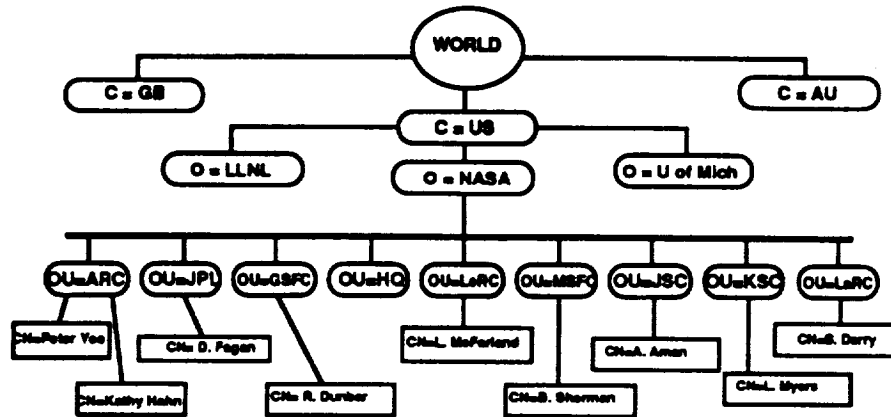
- May be requested (advisory) or refused (actual) by DUA.
- Application layer gateway service.
- Chaining and referrals may be used in combination.
- Mostly transparent to the user.

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Information and Communications Systems Division

What's in the Directory?

Data is organized in a Directory Information Tree:



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What's in the Directory?

Problems:

- Fails to address directly the needs of multi-national / international organizations such as:
 - United Nations
 - European Space Agency
 - International Business Machines
- Not always an efficient way to organize data for searching.

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What's in the Directory?

Entries

- Every vertex and leaf node is an entry.
- Entries are made up of attributes.
- Attributes have types and values.
- Entries have object classes which determine the attributes for the entry.
- Attributes are frequently multivalued and always ASN.1 encoded.
- Attributes and object classes have unique identifiers (OID's).

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What's in the Directory?

Entries (continued)

- Entries each have a Relative Distinguished Name (RDN), which differentiates them from other entries.
- The RDN is made up of selected attribute(s) from the entry - depends on the object classes.
- An entry is uniquely and globally identified by its Distinguished Name - the ordered concatenation of the RDN's for the entry, starting at the root.

c=US@o=NASA@ou=ARC@cn=Peter Yee

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QUIPU - EDB Format

```
cn=Peter Yee
objectClass= top & pilotObject & nwpilotPerson & quipuObject & ehsUser & pilotPerson
sn= Peter Yee & Peter Edward Yee & Peter E. Yee
cn= Yee
title= Electronics Engineer
postalAddress= NASA Ames Research Center 8 MS 233-18 8 Moffett Field, CA 94035-1000
telephoneNumber= +1 415-604-3012
facsimileTelephoneNumber= +1 415-604-6999
userPassword= (CHYPT)PWF/40KJ
mail= yee\40atlascars.nasa.gov & \
      yee\40amsoars.nasa.gov &
drink= Chocolate Milkshake
roomNumber= H233/240
photo= (FILE)
manager= o=US&o=National Aeronautics and Space Administration&ou=Ames Research Center&cn=John Yin
secretary= o=US&o=National Aeronautics and Space Administration&ou=Ames Research \
Center&cn=Katharine Mann
audio= (FILE)
sel= group o=US&o=National Aeronautics and Space Administration&cn=Manager o write o entry & \
      self o write o entry & \
      others o read o entry & \
      group o=US&o=National Aeronautics and Space Administration&cn=Manager o write o default & \
      self o write o default & \
      others o read o default & \
      self o write o attributes o userPassword&accessControlList & \
      others o compare o attributes o userPassword&accessControlList
whoCRAddress= (AM) 302f303d410413025533620e1130894656e656d61696ea20513034152438
3046e413341a30e80033963638103306374637200
```

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Manipulating the Directory Service

Service Primitives

- Read
- Add
- Delete
- Modify
- Compare
- Search
- ModifyRDN

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Manipulating the Directory

Other Functions (DUA supplied)

- Bind
- Unbind
- Move
- Quit!

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QUIPU - What's a QUIPU?

- An implementation of X.500.
- Requires the ISODE to operate.
- Supports non-standard (because there are no such standards) access control, replication, DSA maintenance, and knowledge information.
- Named for information storing strings used by the Incas.

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QUIPU - Data Storage

- Entry Data Blocks (EDBs) used to hold data.
- EDBs are collections of all entries residing at a single level beneath the same point in the DIT.
- Replication works on a whole EDB (single level).
- May be copied between DSAs to enhance performance.
- Completely loaded into core memory during startup.

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QUIPU - Extensions

- Replication
 - Not available in 1988 standard (in 1992 standard).
 - Two schemes supported through use of QuipuDSP and InternetDSP application contexts.
 - QuipuDSP copies EDBs in a single chunk.
 - InternetDSP uses bite-sized chunks to improve reliability in flaky nets.

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QUIPU - Extensions

- Access Control
 - Directory Standards specify how to authenticate users.
 - Don't specify how to manage user access.
 - Currently only simple authentication supported.
 - Strong authentication soon (but may not be in this country).
 - QUIPU defines ACLs (Access Control Lists) for specifying which service primitives may be applied to which attributes and by whom.
 - Search ACLs limit the extent of information retrieval - prevents DIT "trawling."

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QUIPU - Extensions

- DSA Maintenance
 - Orderly DSA shutdown.
 - DSA Information collecting.
 - Disk/Memory Synchronization.
 - Entry Locking.
 - Replication Control.
 - Data Dump.

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QUIPU - Extensions

- Knowledge Information
 - Allows a QUIPU DSA to know which entries it holds.
 - Allows a QUIPU DSA to find entries it does not hold.
 - Allows a QUIPU DSA to contact other DSAs.
 - Knowledge Information is contained within the directory (neat trick!)

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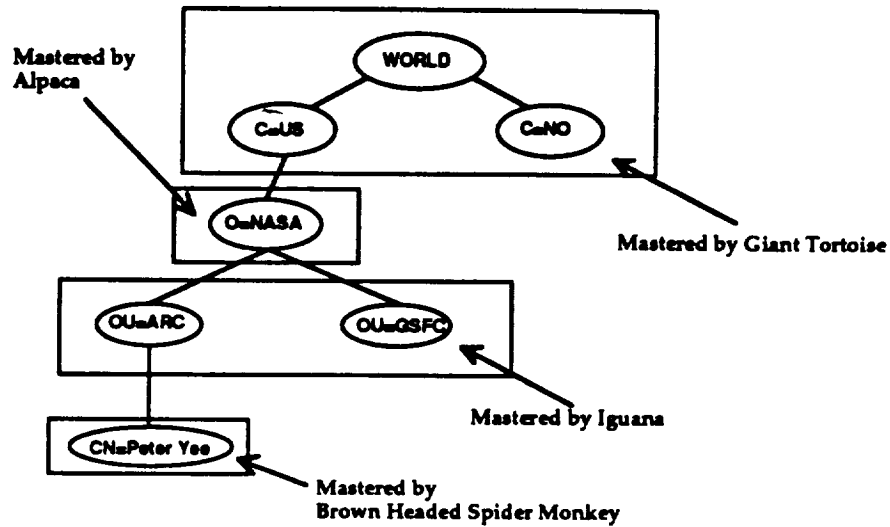
Mastering of Information

- Because all sibling entries are stored in a single EDB, they are all mastered by the DSA holding that EDB.
 - This is a limitation of QUIPU, but it simplifies operations greatly!
- Thus, all organizations within a country are mastered by a single DSA, for example.
 - Requires cooperative maintenance.
 - Newer versions of QUIPU allow DSA information to be mastered by the DSA itself and shadowed by the DSA above it.
 - Confusing!

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Mastering of Information



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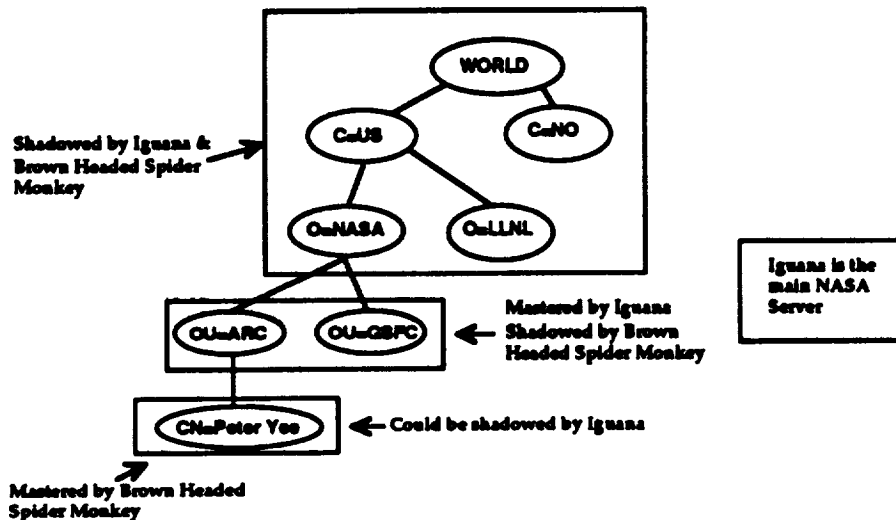
Shadowing of Information

- Means DSA keep a copy of data that the DSA does not master.
- Done for speed and robustness.
- Typically applies to levels above the DSA in question (but could be lower).

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Shadowing of Information



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QUIPU - Information Storage under UNIX

- Uses UNIX directories to recreate DIT hierarchy.
- For example:
 base directory: /usr/etc/quipu/iguana
 - root of DIT stored here
 C=US: /usr/etc/quipu/iguana/c=US
 O=NASA: /usr/etc/quipu/iguana/c=US/o=NASA
 OU=LeRC: /usr/etc/quipu/iguana/c=US/o=NASA/ou=LeRC
- This can make for very long path names!
- EDB for data under each vertex of the tree stored in its corresponding UNIX directory.
- Same for EDBs containing leaf entries.

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QUIPU - Information Storage under UNIX

- Remember, though, that the entry information for each vertex is found in the EDB located one directory above the vertex directory!
 - Information on ou=LeRC is found in the EDB residing in O=NASA.
 - Information about LeRC personnel is found in the EDB residing in OU=LeRC.

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QUIPU - EDB Format

- 1st line: MASTER or SLAVE.
 - Indicates if EDB is original or copy.
- 2nd line: UTC timestamp
 - Used to control replication.
 - Updated every time an entry in the EDB is added/deleted/modified.

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QUIPU - EDB Format

- Entries represented by consecutive attributes and separated by blank line.
- Attributes are written as:

Type = Value

- Type is attribute type (in string form, not usually as an OID).
- Value is as appropriate for the attribute's syntax.
- Special value tags of
 - {ASN} - ASN.1 encoded value in hex string format.
 - {FILE} - external file reference.
 - {CRYPT} - value is encrypted by a one-way hash function.

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QUIPU - EDB Format

- First attribute is the one used to make the RDN.
 - Multivalue attributes may be on separate lines or joined -- it does not matter.
 - Object class attribute determines what other attributes an entry has:
 - e.g. Person must have a name (really a "common name" and surname).
- Defined in the oidtable.oc file.

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QUIPU - EDB Format

```
MASTER
9110020925038
sn=Paul Abarbanel
lastModifiedBy= e-US-National Aeronautics and Space Administration
lastModifiedTime= Wed Oct 2 02:25:03 1991
telephoneNumber= (804) 864-2210
textEncodedAddress= e-usa,admd=telemail,prnd=lars,org=nasa,cu=10001,gn=saui,sn=abarbanel
roomNumber= 1192C/164
sn= Abarbanel
sn= Paul Abarbanel
objectClass= top & person & pilotPerson & quipuObject & thornObject & thornPerson

sn= Kathy Abbott
lastModifiedBy= e-US-National Aeronautics and Space Administration&cn=Manager
lastModifiedTime= Wed Oct 2 02:25:03 1991
telephoneNumber= (804) 864-2018
textEncodedAddress= e-usa,admd=telemail,prnd=lars,org=nasa,cu=13001,gn=kathy,sn=abbott
roomNumber= 116B/117
sn= Abbott
sn= Kathy Abbott
sn= Kathy H. Abbott
objectClass= top & person & pilotPerson & quipuObject & thornObject & thornPerson
```

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Running Your Own DSA

- Obtain software
 - from uu.psi.com, via anonymous FTP
 - from Peter Yee
- Build software
 - instructions included
 - assistance available from Peter Yee
- Install
 - configure support files
- Obtain upper level data
 - ask that Peter Yee person
- Obtain and convert local data
 - roll your own (no standard data format available within the agency).
 - sample conversion programs available from previously mentioned individual.

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Running Your Own DSA

- Read the nice, thick QUIPU manual.
 - Really should do this first.
 - Copy included with software.
 - TeX
 - Postscript
- Take X-Tel course when available.
 - An in depth tutorial on QUIPU by its authors.
 - Currently only offered in Great Britain.
 - May be at Spring InterOp '92.
- In the meantime, visit the X.500 demo.
 - Try out different DUA's on different platforms.
 - Give Greg Brown a hard time!

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Reading List

- The Directory-Overview of concepts, models and service, (ISO/IEC 9594-1, CCITT Recommendation X.500)
- The Little Black Book: Mail Bonding with OSI Directory Services, Marshall T. Rose, Prentice-Hall, 1991 ISBN 0-13-683210-5
- ISODE Manuals
Volume 5, approx 300 pages all about QUIPU
- The Directory-Selected attribute types (ISO/IEC 9594-6, CCITT Recommendation X.520)
- The Directory-Selected object classes (ISO/IEC 9594-7, CCITT Recommendation X.521)

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Support Information

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X.400: /g=peter/s=yee/o=nasa/prmd=arc/admd=telemail/c=us/
X.500: c=US@o=National Aeronautics and Space Administration@
ou=Ames Research Center@cn=Peter Yee

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GUIDELINES FOR IMPROVING SYSTEM SECURITY ON VMS SYSTEMS

NSI User's Working Group (NSIUWG)

April 2, 1992

**Ron Tencall
NSI Security Manager**

1

COMMON VULNERABILITIES

- **IMPROPER PASSWORD PRACTICES**
 - Password=Username
 - Default Accounts
 - Trivial Passwords
- **ACCOUNTING NOT RUNNING**
 - VMS
 - X.25
- **IMPROPER FILE/DIRECTORY PROTECTION SCHEMES**
 - World Readable/Writable
 - Permits Trojan Horses, Worms
- **NETWORK ABUSE**

2



IMPROVING SYSTEM SECURITY

HACKERS ON NSL SITES

HOW THEY GET IN:

- DIAL IN
- NPSS (X.25)
- TCP/IP OR DECNET NETWORK (NSI)

TYPICAL HACKER ACTIVITY:

- TRY TO GUESS PASSWORDS
- EXPLOIT GUEST ACCOUNTS THAT ALLOW OUT OUTBOUND ACCESS
- SEARCH FOR WORLD-READABLE SYSTEM FILES

3



IMPROVING SYSTEM SECURITY

CURRENT VULNERABILITIES BEING EXPLOITED

- TFTP (Used if a node is a boot-server)
Allows files to be read/copied w/out specifying a userid/password
/etc/passwd
- GAINING ROOT ACCESS VIA EXPLOITING UNPATCHED BUGS
- TRIVIAL PASSWORDS

4



IMPROVING SYSTEM SECURITY

EQUIPMENT SECURITY

- LIMIT COMPUTER ROOM ACCESS
- LOCK SYSTEM AND WORKSTATION CONSOLES
- LOG OFF UNATTENDED TERMINALS
- LOG OFF UNATTENDED NETWORK CONNECTIONS

5



IMPROVING SYSTEM SECURITY

ACCOUNT MANAGEMENT

- ACCOUNT REQUEST FORMS
- ONE PERSON PER USERNAME
- DEACTIVATE ACCOUNTS UPON USER TERMINATION OR TRANSFER
- EFFECTIVE USE OF UIC-GROUPS
- ACCOUNT UAF RESTRICTIONS
 - TIME OF DAY
 - LOGIN-CLASS
 - CAPTIVE/RESTRICTED
 - DEFAULT CLI
 - CUSTOMIZED DCLTABLES
 - CPU TIME AND ACCESS TO BATCH QUEUES

6



IMPROVING SYSTEM SECURITY

PASSWORD SELECTION AND MANAGEMENT

- ADEQUATE LENGTH
- DISABLE PASSWORD RE-USE
- NO COMMON WORDS
- NO PROPER NAMES OR ACRONYMS
- USE NON-ALPHABETIC CHARACTERS (\$,_)
- ADVOCATE PASS-PHRASES

7



IMPROVING SYSTEM SECURITY

SECURITY/ACCESS CONTROLS PASSWORD ADMINISTRATION

- SYSTEM PASSWORD
- SECURE_SERVER
- SECONDARY PASSWORDS

8



IMPROVING SYSTEM SECURITY

SECURITY/ACCESS CONTROLS

BREAKIN DETECTION

- SYSGEN /LGI PARAMETERS
- VMS AUDIT COMMANDS
 - \$ SET AUDIT/ENABLE=BREAKIN=ALL
 - \$ SET AUDIT/ALARM/EABLE=LOGIN=NETWORK
 - \$ REPLY/ENABLE=SECURITY
 - \$ SHOW INTRUSION

9



IMPROVING SYSTEM SECURITY

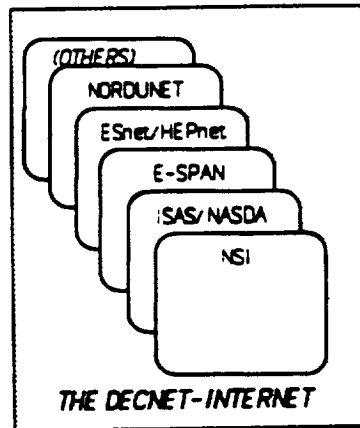
SECURITY/ACCESS CONTROLS

FILES, OBJECTS AND DEVICES

- UIC-BASED PROTECTION
 - DEFAULT SHOULD BE (W:NONE)
- ACCESS CONTROL LISTS
 - MONITOR ACCESS TO SENSITIVE FILES
 - ALLOW/RESTRICT ACCESS TO RESOURCES
 - CONTROL EXTENT OF ACCESS BY NETWORK USERS

10





EVERY NODE HAS A UNIQUE NAME AND ADDRESS CONSISTING OF AN AREA NUMBER AND A NODE NUMBER OF THE FORM:

AREA.NODE

EX: 2.11

WHICH TRANSLATES INTO A UNIQUE INTEGER ADDRESS BY USING THE FORMULA:

$(\text{AREA} \# 1024) \cdot \text{NODE}$

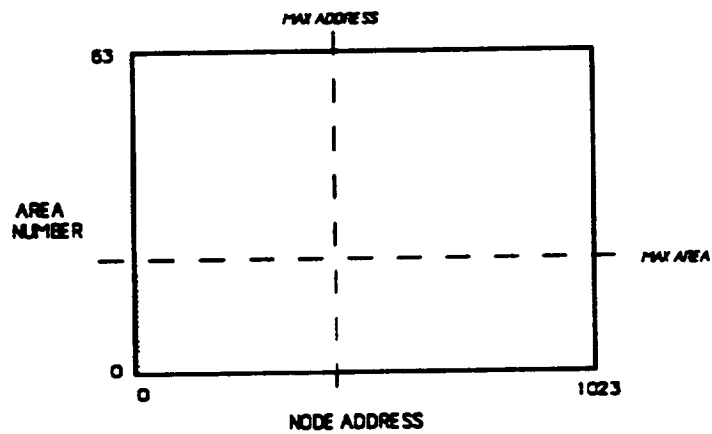
EX: 2059::

\$ SHOW TIME

11-SEP-1991 1020:59

11

FILTERING UNKNOWN NODES



12

CONTROLLING NODE ACCESS WITH NCP

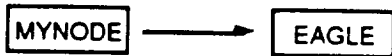
NCP>SET NODE EAGLE ACCESS *BOTH*



NCP>SET NODE EAGLE ACCESS *INCOMING*



NCP>SET NODE EAGLE ACCESS *OUTGOING*



NCP>SET NODE EAGLE ACCESS *NONE*



13

\$ TYPE REMOTE "USER PASSWORD": FILE.EXT

⋮

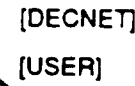
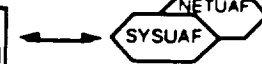
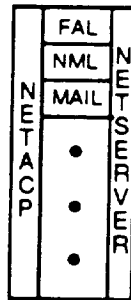
\$ TYPE REMOTE::FILE.EXT

⋮

\$DIR REMOTE::

⋮

\$COPY <FILE> REMOTE::



LOCAL NODE

REMOTE NODE

14

VAX/VMS V5.4 on node FOOBAR 14-SEP-1992 09:41:39.09 Uptime 1 23:12:59

Pid	Process Name	State	Pri	I/O	CPU	Page fts	Ph. Mem
20600200	NULL	COM	0	0	0 07:01:45.32	0	0
20600201	SWAPPER	HIB	16	0	0 00:01:24.32	0	0
20602002	PERIDOT	LEF	14	354	0 00:00:01.00	1192	769
20600206	ERRFMT	HIB	8	4258	0 00:00:09.28	73121	
20600207	CACHE_SERVER	HIB	16	830	0 00:00:00.16	60112	
20600208	CLUSTER_SERVER	HIB	9	720	0 00:00:03.27	119	308
20600209	OPCOM	LEF	14	4687	0 00:00:14.49	6001	235
2060020A	JOB_CONTROL	HIB	9	55765	0 00:03:06.67	200	351
2060020B	CONFIGURE	HIB	13	280	0 00:00:00.09	101	150
2060020F	SYMBIONT_0001	HIB	9	674	0 00:00:02.93	5016	76
20600211	NETACP	HIB	10115381		0 00:07:05.26	1146	1066
20600212	EVL	HIB	4	365212	0 00:07:11.38	353897	140 N
20600214	REMACP	HIB	9	2934	0 00:00:03.13	98	89
2060203B	DSMITH	LEF	4	1369	0 00:00:09.04	5295	336
20600217	SERVER_24120	LEF	14	956	0 00:00:05.79	4397	282 N
2060044F	OPERATOR	LEF	14	4101	0 00:00:15.62	8251	276
20602051	BLAKE	LEF	4	334	0 00:00:02.29	964	339
2060106D	SERVER_106D	LEF	14	1952	0 00:00:03.96	2390	290 N

15

NETSERVER\$TIMEOUT

- Length of time "server" processes live after object termination

RECOMMENDATION

\$DEFINE/SYSTEM/EXEC NETSERVER\$TIMEOUT "0000 00:00:00.01"

- Each network connection in its own NETSERVER.LOG
- VMS Accounting Record for EACH Network Access
- Process creation each time a network object invoked

16

NETSERVER.COM

- Invoked each time a new "server" process starts up
- Services incoming network connections for an object
- Waits for NETSERVER\$TIMEOUT or 25 Connections
 - Multiple Connections per NETSERVER.LOG
- Purges NETSERVER.LOG

RECOMMENDATION:

- Comment out the line that Purges NETSERVER.LOG
(This change not supported by DEC)

17



SYSS\$SYSTEM:NETSERVER.COM

```

      :
      :
$ IF PERMANENT_NETSERVER_COUNTER.LT.25 THEN GOTO LOOP
$ PERMANENT_NETSERVER_COUNTER = 0
$ SET NOON
$ DEASSIGN SYS$OUTPUT
$ DEFINE SYS$OUTPUT NETSERVER.LOG
$ WRITE SYS$OUTPUT "NETSERVER.LOG - NEW VERSION CREATED '" $TIME()'"
$ SET ON
$ GOTO LOOP
$ !
$ !FIRST TIME THROUGH. PURGE OLD LOGS.
$ !ALSO, SEE IF THERE ARE ANY PERMANENT NETSERVER SLOTS OPEN...
$ !
$!STARTUP_NETSERVER:
$ STARTUP_FLAG = "N"
$ IF $SEARCH (SYS$LOGIN:NETSERVER.LOG;*.*.N) .NES. THEN-
$   PURGE / KEEP -3 SYS$LOGIN:NETSERVER.LOG
      :
      :

```

18



PROTECT NETSERVER.LOG

- Deters unauthorized browsing/deletion of NETSERVER.LOG
- Impossible to completely "cover one's tracks"
- Suggest (S:RWD,O,G,W)

19

NETSERVER.LOG PROTECTION

[- NETSERVER.LOG protected (S:RWD, O:RWD, G:RE, W) -]

[DECNET] owns the file

\$ DELETE ROBIN :: NETSERVER.;"

%DELETE-W-FILNOTDEL, error deleting ROBIN :: DECNET\$: [FAL]NETSERVER.LOG;39
-RMS-E-FLK, file currently locked by another user
%DELETE-I-FILDEL, ROBIN :: DECNET\$: [FAL]NETSERVER.LOG;38 deleted (8 blocks)
%DELETE-I-TOTAL, 1 file deleted (8 blocks)

\$ TYPE ROBIN :: NETSERVER.LOG

.....
Connect request received at 9-MAY-1990 13:50:38.18
from remote process LARK :: "O-TENCATI "
for object "SYS\$SYSROOT:[SYSEXE]FAL.COM"
.....

20

NETSERVER.LOG PROTECTION (Cont.)

=====

FAL V04-000 started execution on 9-MAY-1990 13:50:39.57
with SYSSNET = LARK : : *0=TENCATI * and
with FAL\$LOG = 1

Requested file access operation: Open File
Specified file: DECNET\$: [FAL]NETSERVER.LOG;39
DAP status code of 4030 generated
Requested file access operation: Erase File
Specified file: DECNET\$: [FAL]NETSERVER.LOG;39
DAP status code of 4030 generated

Requested file access operation: Open File
Specified file: DECNET\$: [FAL]NETSERVER.LOG;38
Resultant file: DECNET\$: [FAL]NETSERVER.LOG;38
File access was terminated with DLT bit set on close

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USING FAL\$LOG TO ENHANCE AUDITS

- UNDOCUMENTED FEATURE (Debugging?)
- Inserts extended information into NETSERVER.LOG
- Bit-mask (Best defined as a character string):
 - Bit 0 - Enables logging of Filename(s)
 - Bit 1 - Enables generation of throughput statistics
 - Bit 2 - Enables logging of DAP messages
 - Bit 3 - Enables logging of xmit and recv AST completions
 - Bit 4 - Enables logging of xmit and recv QIO requests
 - Bit 5 - Reserved
 - Bit 6 - Disables DAP message blocking
 - Bit 7 - Disables DAP CRC error checking
 - Bit 8 - 31 Reserved

Examples:

```
$DEFINE/SYS/EXEC FAL$LOG 1
$DEFINE/SYS/EXEC FAL$LOG "3/DISABLE=8"
(Disables "poor man's routing")
```

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NETSERVER.LOG PROTECTION (Recommended Setting)

[- .NETSERVER.LOG protected (S,RWED,O,G,W) -]

\$ DELETE ROBIN :: NETSERVER.LOG,*

Error deleting ROBIN :: DECNET\$: [FAL]NETSERVER.LOG,69
Insufficient privilege or file protection violation

\$ TYPE ROBIN :: NETSERVER.LOG

.....
Connect request received at 9-MAY-1990 16:02:07.51
from remote process LARK :: "0=TENCATI"
for object "SYS\$SYSROOT:[SYSEXE]FAL.COM"

FAL V4.6-00 started execution on 9-MAY-1990 16:02:07.95
with SYS\$NET = LARK :: "0=TENCATI" and
with FAL\$LOG = 1

Requested file access operation: Open file
Specified file: DECNET\$: [FAL]NETSERVER.LOG,69
DAP status code of 4055 generated

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DEFAULT DECNET ACCESS

\$ DIR ROBIN ::

Directory ROBIN :: DECNET\$: [FAL]

LOGIN.COM,32767	NETSERVER.LOG,2	NETSERVER.LOG,1	NODEINFO.LIS,32767
SPANLOG.COM,32767	STC.BAK,32767	STC046.A,32767	

Total of 7 files

\$ TYPE ROBIN :: NETSERVER.LOG

.....
Connect request received at 3-MAY-1990 14:16:41.46
from remote process LARK :: "0=TENCATI"
for object "SYS\$SYSROOT:[SYSEXE]FAL.COM"

[- - Additional Information Provided by FAL\$LOG - -]

FAL V4.6-00 started execution on 3-MAY-1990 14:16:45.19
with SYS\$NET = LARK :: "0=TENCATI" and
with FAL\$LOG = 1

Requested file access operation: Directory List
Specified file: *.*
Resultant file: DECNET\$: [FAL]LOGIN.COM,32767
Resultant file: DECNET\$: [FAL]NETSERVER.LOG,2
Resultant file: DECNET\$: [FAL]NETSERVER.LOG,1
Resultant file: DECNET\$: [FAL]NODEINFO.LIS,32767
Resultant file: DECNET\$: [FAL]SPANLOG.COM,32767
Resultant file: DECNET\$: [FAL]STC.BAK,32767
Resultant file: DECNET\$: [FAL]STC046.A,32767

FAL terminated execution on 3-MAY-1990 14:16:47.16

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POOR MAN'S ROUTING

\$ DIR ROBIN :: LARK :: *.*

Directory ROBIN :: LARK :: [DECNET]

DTR.LOG:53	EXENET.COM:1	FAL.LOG:80	LOGIN.COM:3
MIRROR.LOG:4	NETSERVER.LOG:1575	NETSERVER.LOG:1574	NETSERVER.LOG:1573
NETSERVER.LOG:82	NML.LOG:17	NT.LOG:1	TMPFILE.LOG:3
TTA4.MEM:1			

Total of 13 files.

\$TYPE LARK :: NETSERVER.LOG

```

.....
Connect request received at 9-MAY-1990 13:19:31.44
from remote process ROBIN :: "0=DECNET" for
object "SYS$SYSROOT:[SYSEXE]FAL.COM"
.....

```

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POOR MAN'S ROUTING (CONT)

[-- FAL\$LOG Set to "1/DISABLE = 8" on Robin --]

(FROM LARK):

\$DIR ROBIN :: EAGLE :: *.*

%DIRECT-E-OPENIN, Error opening ROBIN :: EAGLE :: *.* as input.

-RMS-F-NOD, Error in node name

\$TYPE ROBIN :: NETSERVER.LOG

```

.....
Connect request received at 9-MAY-1990 13:19:31.44
from remote process LARK :: "0=TENCATI"
for object "SYS$SYSROOT:[SYSEXE]FAL.COM"
.....

```

```

.....
FAL V4.6-00 started execution on 9-MAY-1990 13:19:31.44
with SYS$NET = LARK :: "0=TENCATI" and
with FAL$LOG = 1/DISABLE=8
.....

```

```

Request file access operation: Directory List
Specified file: EAGLE :: *.*
DAP status code of 4086 generated
.....

```

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SELECTED DECNET/DAP STATUS CODES

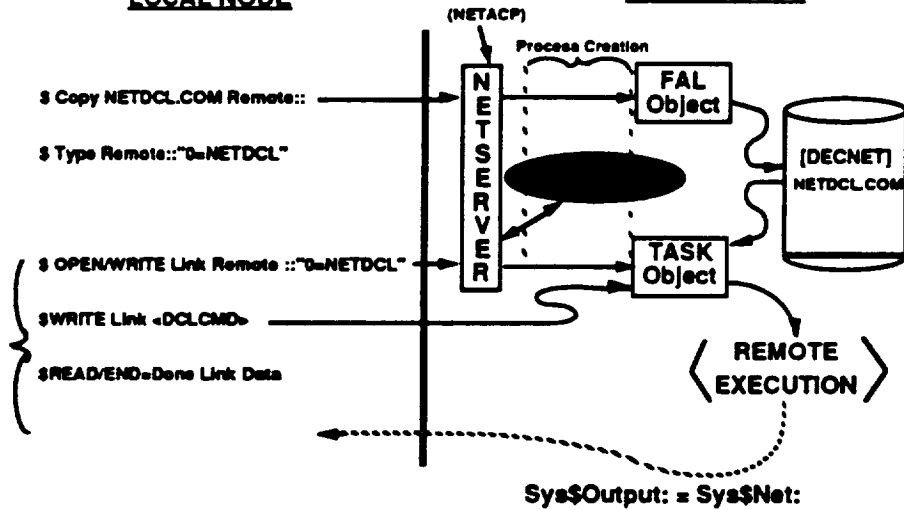
DAP CODE	Corresponding VMS Error Message
401D :	Error in Device Name or Inappropriate Device...
401E :	Error in Directory Name
4020 :	Directory Not Found
4030 :	File Locked by Another User
4032 :	File Not Found
4053 :	Insufficient Privilege or File Protection Violation
4086 :	Invalid Channel (Poor Man's Routing Attempted/Disabled)
4097 :	Syntax Error in Filename
10D7 :	} Related to Sending Mail Across Node
10D9 :	
5D60 :	
Success :	"File Access was Terminated with No Bits Set on Close"
Deleted :	"File Access was Terminated with DLT Bit Set on Close"

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TASK-TO-TASK COMMUNICATION

LOCAL NODE

REMOTE NODE



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SHOWSYS.COM:

```
$ DEFINE SYSS$OUTPUT SYSS$NET
$ SHOW SYSTEM
$ EXIT
```

\$ TYPE EAGLE::"0=SHOWSYS"

- REQUIRES THAT THE TASK OBJECT BE PRESENT

.....

```
NCP> DEFINE OBJECT SHOSYS NUMBER 140
      FILE ddcu:[DIR]SHOWSYS.COM USER FRED PASS password
```

\$ TYPE EAGLE::"140="

- DOES NOT USE THE TASK OBJECT

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USING SEPARATE OBJECT USERID'S

- Each object gets its own VMS accounting record
- Objects can be assigned identifiers for use in ACL's
- Removal of userid/password from Executor database
- Define each object with NCP:

Example:

```
NCP>DEFINE OBJECT FAL USER FAL OBJ PASSWORD XYZZY
NCP>DEFINE OBJECT MAIL USER NETUSER PASSWORD PONEYEXPRESS
```

- A configuration option under V5.2 and higher

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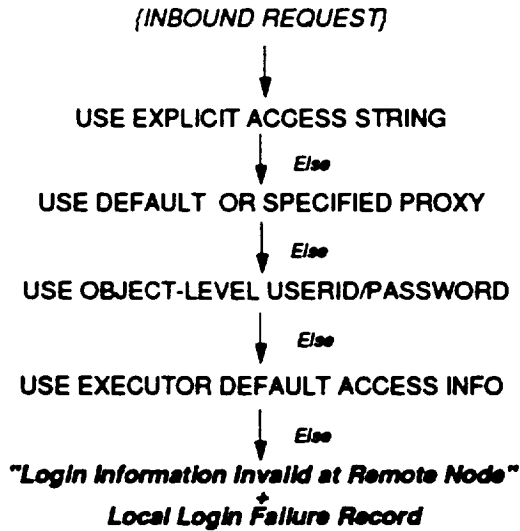
DECNET OBJECT DATABASE

Known Object Volatile Summary as of 2-MAY-1989 20:21:13

Object	Number	File/PID	User Id	Password
\$MOM	0	SYSS\$SYSTEM:MOM.COM	DECNETUSER	DEFAULT_PWD
\$NICONFIG	0	SYSS\$SYSTEM:NICONFIG.COM	DECNETUSER	DEFAULT_PWD
\$TASK	0	SYSS\$MANAGER:TASKLOG.COM		
\$MISERVER	0	2020008C	NET_NML	RESTRICT\$ACCESS
TASK	0	SYSS\$MANAGER:TASKLOG.COM		
FAL	17	SYSS\$SYSTEM:FAL.COM	FAL	FAL_USE_PWD
HLD	18	SYSS\$SYSTEM:HLD.COM	DECNETUSER	DEFAULT_PWD
NML	19	SYSS\$SYSTEM:NML.COM	NET_NML	RESTRICT\$ACCESS
REMACP	23	20200084		
MIRROR	25	SYSS\$SYSTEM:MIRROR.COM	DECNETUSER	DEFAULT_PWD
EVL	26	20200082		
MAIL	27	SYSS\$SYSTEM:MAIL_SERVER.EXE	NETMAIL	BILL_COLLECTOR
PHONE	29	SYSS\$SYSTEM:PHONE.COM	PHONE	BUSY\$SIGNAL
DDMF	30	SYSS\$SYSTEM:DDMV.COM	DECNETUSER	DEFAULT_PWD
CTERM	42	20200084		
VPM	51	SYSS\$SYSTEM:VPM.EXE		
\$PM\$REMOTE	60	SYSS\$SYSTEM:\$PM\$COLLECT.EXE		
DTR	63	SYSS\$SYSTEM:DTR.COM		
FINGER	117	FINGER\$DIRECTORY:FINGER.EX	NET_FINGER	ALL\$THUMBS

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CONNECTION SUMMARY



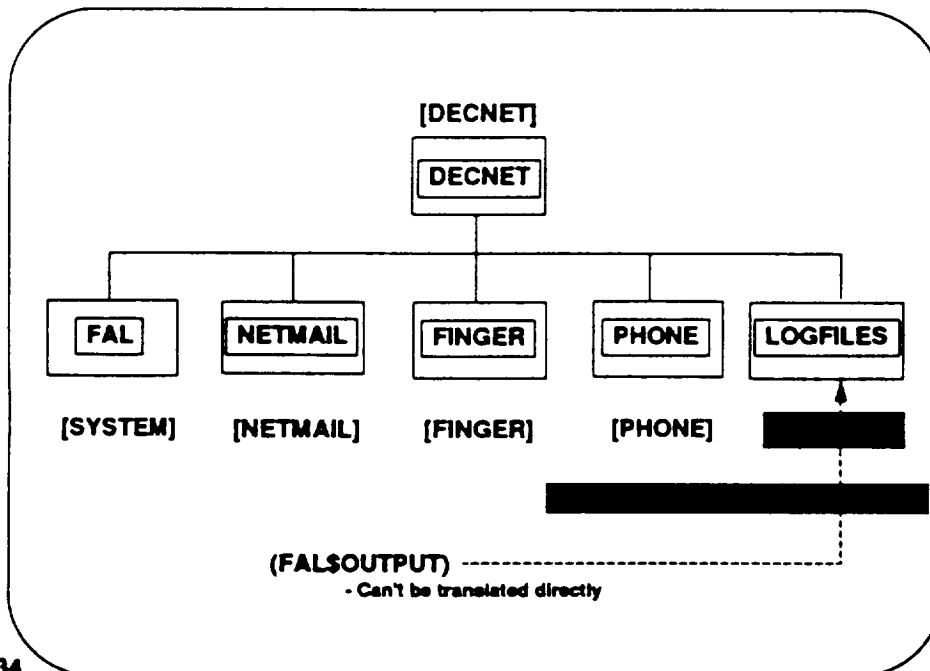
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SAMPLE UAF RECORD

Username: DECNET		Owner: DECnet Default
Account: NETWORK		UIC: [376,376] ([DECNET])
CLI: DCL		Tables:
LGICMD: NL:		
Login Flags: Discly Lockpwd Restricted		
Primary days: Mon Tue Wed Thu Fr		
Secondary Days: Sat Sun		
Primary: 000000000011111111112222		Secondary: 000000000011111111112222
Day Hours 012345678901234567890123		Day Hours 012345678901234567890123
Network: #####Full access#####		#####Full access#####
Batch: No Access		No Access
Local: No Access		No Access
Dialup: No Access		No Access
Remote: No Access		No Access
Expiration: (none)		Pwdminimum: 6 Login Fails: 0
Pwdlifetime: 180 00:00		Pwdchange: 6-FEB-1989 17:03
Last Login: 4-NOV-1989 12:41 (interactive), 14-SEP-1989 11:00 (non-interactive)		
Maxjobs: 0	Film: 120	Bydm: 20500
Maxacctjobs: 0	Shrfilm: 0	Pbydm: 0
Maxdetach: 0	BIQIm: 18	JTquota: 1024
Prclm: 0	DIOIm: 24	WSdef: 1024
Pno: 4	ASTIm: 24	WSquo: 2048
Quepno: 0	TQEIm: 10	WSextent: 2048
CPU: 0 00:01:00	Enqim: 400	Pgflquo: 16000
Authorized Privileges: TMPMBX NETMBX		
Default Privileges: TMPMBX NETMBX		

• Every Network object should have a separate Userid with the above configuration. (Unique UIC's)

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LOGGING NETWORK CONNECTIONS

- Provides hardcopy proof of connection
- Easier monitoring of DECNET activity
- Suggested implementations:
 - \$SET AUDIT/ALARM/ENABLE=LOGIN=NETWORK
(Extractable with SECAUDIT.COM)
 - Make an LGICMD file each object "user" runs:


```
$User = F$Logical ("SYS$REM_ID")
$node = F$Logical ("SYS$REM_NODE")
$Request/To = Network -
"Network Connect From Node"Node"User"User"
$Exit
```

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NETWORK AUDIT TRAILS

\$ SET AUDIT/ALARM/ENABLE=LOGIN=NETWORK

```
%%%%%%%%%% OPCOM 3-MAY-1990 10:25:00.51 %%%%%%%%%%
Security Alarm on MYNODE / Network Login
Time:      03-MAY-1990 10:25:00.46
PID:      00001F65
User Name: NET_FAL
Source:    5.143 EAGLE::TENCATI
```

```
UAF > MODIFY NET_FAL/LGICMD=NET_LOG.COM
NCP> SET OBJECT FAL USER NET_FAL PASSWORD <password>
```

```
%%%%%%%%%% OPCOM 3-MAY-1990 10:25:03.74 %%%%%%%%%%
Message from user NET_FAL on MYNODE
FAL_15390, Network Connect From Node: EAGLE, Username: TENCATI
```

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Sample Output From NETLOG.COM

Date	Start Time	Remote Node	Remote Userid	Connect Time	Local Username	Record Type
10-MAY-88	07:53:42	HAMLET	2080012C	00:00:35	NETMAIL	Mail
10-MAY-88	07:53:54	WRF	DLINKERT	00:00:53	NETMAIL	Mail
10-MAY-88	07:53:27	MARVAX	DECNET	00:00:27	FAL	
10-MAY-88	08:00:31	MARVAX	DECNET	00:00:41	FAL	
10-MAY-88	07:58:03	IFLAG2	00000422	00:08:07	NETMAIL	Mail
10-MAY-88	08:02:59	JPLRAG	OLSEN	00:01:09	OLSEN	<Login>
10-MAY-88	08:03:25	MARVAX	DECNET	00:01:02	FAL	
10-MAY-88	08:05:25	MARVAX	DECNET	00:00:28	FAL	
10-MAY-88	08:28:38	UCMBO	21000094	00:00:28	NETMAIL	Mail
10-MAY-88	08:38:50	LAMPS	KWAIGHT	00:00:19	PHONE	
10-MAY-88	08:38:40	CASS01	00000110	00:04:29	NETMAIL	Mail
10-MAY-88	08:48:06	JPLMAD	PAULSON	00:00:16	PHONE	
10-MAY-88	09:04:45	LOCK	HACK	00:00:26	NETMAIL	Mail
10-MAY-88	09:08:08	LOCK	HACK	00:03:12	NETMAIL	Mail
10-MAY-88	09:12:20	DIRAC2	KERR	00:02:58	NETMAIL	Mail
10-MAY-88	09:15:24	ASD	LEHMAN	00:00:21	NETMAIL	Mail
10-MAY-88	09:18:14	EROSA	SYSTEM	00:00:18	PHONE	
10-MAY-88	09:20:56	JPLRAG	SYSTEM	00:00:53	NETMAIL	Mail
10-MAY-88	09:21:26	HAMLET	2080412B	00:00:26	NETMAIL	Mail
10-MAY-88	09:32:19	SWRI	0000078C	00:00:34	NETMAIL	Mail
10-MAY-88	09:46:21	JPLSP	BGOLDSTEIN	00:03:44	NETMAIL	Mail
10-MAY-88	09:31:57	CYCLOP	00001D9C	00:30:22	NETMAIL	Mail
10-MAY-88	11:52:39	NSSDCA	CROMP	00:00:44	NETMAIL	Mail
10-MAY-88	15:23:39	LHEAVY	000004AA	00:00:46	NETMAIL	Mail

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IMPROVING SYSTEM SECURITY

IMPROVING SECURITY - GENERAL

- USE PASS-PHRASES
- REQUIRE PASSWORDS ON ALL ACCOUNTS
- ONE ACCOUNT PER USERNAME
- GENERATE AUDIT TRAIL (ACCOUNTING) DATA - REVIEW DAILY
- INSTALL PATCHES AS THEY BECOME AVAILABLE
- RUN SECURITY "TOOLKIT" SOFTWARE
UNIX: "COPS" VMS: "SPAN TOOLKIT"
- REPORT INCIDENTS WHEN THEY HAPPEN

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IMPROVING SYSTEM SECURITY

IMPROVING SECURITY - VMS

- NO TASK OBJECT
- SEPARATE USERIDS FOR DECNET OBJECTS
- USE NETSERVER\$TIMEOUT AND FAL\$LOG TO ENHANCE AUDIT TRAILS
- USE ACCESS CONTROL LISTS
- RESTRICT FTP TO PARTICULAR DIRECTORY
- USE PSI_SECURITY TO FILTER X.25 CONNECTS TO/FROM VALID DTE'S ONLY

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INCIDENT HANDLING

- DO NOT REPORT NSI/NASA INCIDENTS TO THE "CERT"
- USERS SHOULD REPORT ANY ANOMALY TO THEIR SYSTEM ADMINISTRATOR
- SYSTEM ADMINISTRATORS SHOULD REPORT ANY SECURITY INCIDENT TO THEIR DPI-CSO
- IF INCIDENT INVOLVES AN EXTERNAL SITE, REPORT IT ALSO TO NSI-SECURITY OFFICE, SECURITY@NSINIC.GSFC.NASA.GOV
- NSI SECURITY OFFICE ISSUES SECURITY BULLETINS TO NSI COMMUNITY VIA ROUTING CENTER MANAGERS AND NASA AIS CONTACTS

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IMPROVING SYSTEM SECURITY

SECURITY MANAGEMENT TOOLS

- NSI SECURITY BULLETINS
- PASSWORD MONITORING/COMPLIANCE SOFTWARE
- DECNET CONNECTION SUMMARY REPORT GENERATOR
- PSI ACCOUNTING
- PSI CONNECTION/USER SUMMARY REPORT GENERATOR
- SPAN TOOLKIT
- LLNL SPI/VMS TOOLKIT

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UNIX* Security

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Lawrence Livermore National Laboratory

3rd Annual NSIUWG Conference
April 2, 1992

* - UNIX is a registered trademark of AT&T

Major purposes of this presentation

- **To familiarize you with some of the major security problems in UNIX**
- **To acquaint you with methods of making your UNIX system more secure, regardless of whether you are a user or system manager**

1-2

About the security of the UNIX operating system

- **UNIX was designed for use in "trusted" computing environments**
- **As UNIX has moved towards becoming a de facto standard, it is being used more in sensitive and classified computing environments**
- **The UNIX kernel is secure, but the applications/utilities are often not**
- **UNIX contains many security features, but they usually must be enabled**
- **As new features are added to UNIX, security has become more difficult to control**

1-3

What really is the problem?

- **FACT - 90 percent or more of the intrusions into UNIX systems would never occur if two widespread problems were corrected**
 - **Weak passwords**
 - **Unpatched vulnerabilities**

1-4

Other causes of security problems

- **Improper permissions (especially file permissions)**
- **Improper system configuration**
- **Use of programs and functions that compromise security**
- **Lack of security maintenance activity**
- **Inadequate network security architecture**

1-5

Some dangers of an attacker obtaining root privileges

With root privileges on a system an attacker can

- **Create new accounts**
- **Disable any account**
- **Read, write to, or delete any file on that system, regardless of any protections placed on that file**
- **Intercept and read anyone's e-mail**
- **Install trojan horse programs on that system**
- **Delete any system accounting files (/etc/utmp, /etc/wtmp, usr/admin/lastlog)**

1-6

Some dangers of an attacker obtaining root privileges (continued)

- **Modify data (e.g., change value of pi to 3.4)**
- **Kill any process that is running**
- **Login to any other system that trusts the
compromised host without using a password, and
do the same!**

1-7

UNIX Security

Overview

Password Management

File Protection

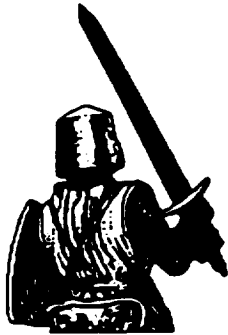
System Configuration

Vulnerabilities

A Final Note

1-8

Passwords



**More UNIX incidents start with
because of poor or nonexistent
passwords than any other cause!**

1-9

Evidence of password problems

- In The Cuckoo's Egg
- During the 1988 Internet worm attack
- Intrusions into U.S. UNIX systems from Germany, England, Australia, The Netherlands, etc. from 1987 - present
- Intrusions into U.S. UNIX systems from overseas during Operation Desert Shield/Desert Storm

1-10

Evidence of password problems (continued)

- Klein's study in 1990 showed that of a total of 15,000 passwords in password files from 50 sites
 - 3% could be found by a password cracking program within 10 minutes
 - 21% could be cracked by this program in 1 week
 - Approximately two-thirds of systems involved in study could be compromised by at least one bad password

I- 11

How attackers obtain passwords

- By guessing
- By cracking password files
- From bulletin boards
- From e-mail messages and files in compromised accounts
- By social engineering—"con jobs" on unsuspecting users to obtain passwords

I- 12

"Joe" accounts

Accounts with the same user name and password

User = jabstar
Password = jabstar

1-13

Weak (easy-to-guess) passwords

- **Simple variations (e.g., rnjones, jonesrn, rjones, ronjones) or reversals of a username**
- **Any word found in the English dictionary**
- **Popular car makes**
- **First names**
- **Computer (and other) slang (e.g., guru, wizard, etc.)**
- **Yiddish or Chinese words**
- **Simple letter iterations (e.g., ababab)**

1-14

Frequently found default passwords

root
diag
sysdiag
sundlag
maint
sync

1- 15

Unpassworded accounts

- **Some accounts have no password at all**
 - **Examples: root* and uucp**
 - **Frequent reason: convenience of users**
 - **Easy target for attack**
- **If there is no password for modem dial-ins, once an attacker has the dial-in number a system is subject to multiple attacks involving different accounts**

* - Some but not all UNIX vendors ship systems with an unpassworded root account

1- 16

Choosing a sound password

- **Requires some inconvenience on the user's part**
- **Recommended methods**
 - **Short word + control character + short word unrelated to first, e.g., tie&shirt**
 - **Mnemonic method—using first letter of each word in an easily remembered phrase, e.g., mctotslol (my Country tis of thee...sweet land of liberty)**
- **Avoid using any password less than 7 - 8 characters in length**

1-17

Checking for easily guessed passwords

- **Proactive approach—when the password is set**
 - **Replace the procedure for changing the password to check for easily guessed passwords**
 - **Establish policy for setting the initial password to something not easily guessed**
- **Retroactive approach—at regular intervals**
 - **Run a password checker on your system's passwords**
 - **Prepare a policy for finding and changing easily guessed passwords**

1-18

Checking for easily guessed passwords (continued)

- **Install password filtering tool (proactive)**
 - **npasswd** (anonymous ftp to [emx.utexas.edu](ftp://emx.utexas.edu))
 - **passwd+** (contact Matt.Bishop@dartmouth.edu)
 - **Commercially available tools**

OR

- **Use password checking tool (retroactive)**
 - **COPS** (ftp to [cs.purdue.edu](ftp://cs.purdue.edu))
 - **CRACK** (ftp to [wuarchive.wustl.edu](ftp://wuarchive.wustl.edu)—in vol. 25)
 - **SPI (Security Profile Inspector)** – send e-mail to tencati@nssdca.gsfc.nasa.gov

1-19

Password aging

Requiring users to change their password on a regular basis has some benefits and drawbacks:

- **Can flag and remove dormant accounts**
- **Limits the utility of a stolen password**

BUT

- **Can drive users to choose weak passwords, since the user now has to invent and remember new passwords more frequently**

1-20

Password aging (continued)

- In some UNIX systems password aging can be set by editing `/etc/passwd`

`root:abcdefg|hijklm_n.o.:Whammie!:/bin/csh`



value (in weeks) for password expiration

- Some commercial security packages have password aging
- In "secure" SunOS systems, modify `passwd.adjunct` in `/etc/security`

1-21

Eliminating assessible password files

"Secure" versions of UNIX have shadow password files (i.e., encrypted passwords are stored in a non-accessible file)

`root:*_26:1.:Whammie!:/bin/csh`

login process ↑

`/etc/security, /etc/security or /usr/etc/security`

1-22

Social engineering

OmniCore is experimenting in online - high resolution graphics display on the UNIX BSD 4.3 system and its derivatives. But, we need your help in testing our new product - TurboTetris. So, if you are not too busy, please try out the tetris game in your machine's /tmp directory. Just type:

`/tmp/tetris`

Because of the graphics handling and screen-reinitialization, you will be prompted to log on again. Please do so, and use your real password. Thanks for your support. You'll be hearing from us soon!

OmniCore

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UNIX Security

Overview

Password Management

File Protection

System Configuration

Vulnerabilities

A Final Note

1-24

File protections

- File protections determine who may
 - Read/write to and/or execute a file
 - List, create and search directories
- An attacker may not need to obtain root privileges or break into your account to get what s/he wants from your account if your file protections are not set properly

1-25

File access modes

\$ ls -lg anyfile

~~-rwxrwxrwx~~ 1 gene sys 2 May 1 1991 anyfile

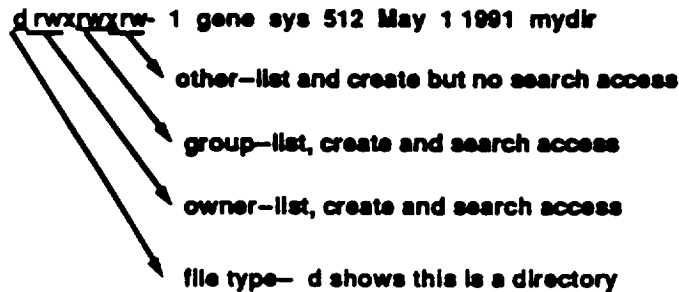
- other—read and write access but no execute allowed
- group—read, write and execute allowed
- owner—read, write, and execute allowed
- file type— - shows this is a file

1-26

Directory access modes

\$ ls -ldg mydir

d rwxrwxrwx- 1 gene sys 512 May 1 1991 mydir



other—list and create but no search access

group—list, create and search access

owner—list, create and search access

file type— d shows this is a directory

1-27

The "bottom line" of file protection

- **Anyone with access to your system can**
 - **Read/copy any of your world-readable files**
 - **Alter/delete any of your world-writable files**
 - **Run any of your world-executable programs**
 - **Plant trojan horse programs in your world-writable directories in your path**
- **Threats to the system itself**
 - **World-writable binaries and system directories allow an attacker to modify the system**
 - **Readable restricted system files allow an attacker to discover other trusted computers or other privileged information**

1-28

Setting the proper file permissions

- In octal method of setting file permissions
 - 4 = read (or *list* in the case of directories)
 - 2 = write (or to add/delete files from a directory)
 - 1 = execute (or to *cd* into a directory)
 - so 761 → owner read-write-execute, group read-write, and world execute only for a file
- To change permissions so that you can read-write-execute, but group or world cannot read-write-execute
 - \$ `chmod 700 anyfile`

1- 29

Setting the proper file permissions (continued)

OR (symbolic method)

\$ `chmod og-rwx anyfile` (group and world now have no read-write-execute access)

- To recursively remove all read access for group and world recursively through your directory structure:

\$ `chmod -R og-r` (BSD systems only)

OR

\$ `find . -exec chmod og-r {} \;`

1- 30

Recommended file permissions

- **For user files and directories:**
 - Any file containing a password: mode X00
 - Hidden files: writable only by owner
 - Directories: writable only by owner, with all files contained therein owned by user
 - If you are not sure, try mode 700 or 711 initially for executable files and 600 or 644 for non-executable files

1-31

Recommended file permissions (continued)

- In general, only root needs to have write permission for system files
- System files should be owned by system users
- root directories (e.g., bin, dev, etc, mnt, usr, etc.) should not have add/delete access by world
- World should not be able to read-write to memory, devices, spool directories, etc.

1-32

Recommended file permissions (continued)

- **netrc (contains login and initialization information for use by ftp's auto-login process) - should be readable only by owner**
- **/usr/adm/utmp or /usr/adm/wtmp - mode 600 or 644**
- **/var/adm/acct or /var/adm/pacct - mode 600**
- **syslog, authlog, or similar files - mode 664 or 644 (recommended directory mode is 700 or 755)**

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umask

- **umask (in /etc/profile or .cshrc file) sets a mask on permissions for files and directories you create**
- **sets limit on maximum permission values (octal)**
- **7 minus umask value = maximum sum of access permissions for each bit, e.g., mask value of 4 allows write (2) and execute (1) only**

\$ umask (displays umask creation mask)

\$ umask 126 (prevents owner from execute, group from read-execute and world from read-write access)

\$ umask 077 (prevents group and world from read-write-execute access)

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UIDs for processes

- **UID - user Identification number**
- **If a process needs to read, write or execute a certain file, the associated UID must have the appropriate access permissions**
- **Real UID - the UID of the user who executes the process**
- **Effective UID - the UID under which the process runs (with the same access permissions/ privileges as the owner of any accessed file)**
- **Example - If user rcarr executes a setuid file owned by gene, the real UID will be rcarr's, but the effective UID will be gene's**

1 - 35

GIDs for processes

- **GID - group Identification number**
- **Real GID - the GID of the group that executes a process**
- **Effective GID - the GID under which the process runs (with associated access permissions and privileges)**

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SUID permission

SUID - Set user ID

- When SUID permission is set, all processes created from program will have effective UID of the *owner* of program
- Effective UID may be different from real UID
- chmod command used to set SUID permission

\$ chmod u+s anyfile OR chmod 4XXX anyfile (sets SUID permission)

\$ ls -lg anyfile

-rwxrwxrwx- 1 gene sys 2 May 1 1991 anyfile

↑
the s replaces the x to show that the SUID permission is set

1-37

SGID permission

SGID - Set group ID

- When SGID permission is set, all processes created from program will have effective UID of the *group* associated with program
- Effective GID may be different from real GID
- chmod command used to set SGID permission

\$ chmod g+s anyfile OR chmod 2XXX anyfile (sets SGID permission)

\$ ls -lg anyfile

-rwxr-sr-x 1 gene sys 2 May 1 1991 anyfile

↑
the s replaces the x to show that the SGID permission is set

1-38

The sticky bit

- If the sticky bit on a directory is set, only the owner of files in that directory can remove or rename those files
 - Applies to SunOS and some other BSD systems
 - Useful especially for /tmp directories (normally world-writable)

`$ chmod 1XXX mydir OR $ chmod o+t`

`$ ls -ldg mydir`

`drwxr-xr-t 1 gene sys 512 May 1 1991 mydir`

↑
the `t` replaces the `x` to show that the sticky bit is set

1-39

setuid root files planted by intruder

- Designed to allow root privileges to intruder upon reentry into system
- Often are hidden* (e.g., `.xx`, `..`, etc)
- setuid root program might be `/bin/sh`
- To find setuid root files:

`$ find / -user root -perm -4000 -print`

* - Hidden files begin with a period

1-40

Recommendations for setuid

- **setuid root scripts**
 - Your vendor can inform you which scripts need to run as root – other setuid root scripts should not be allowed
 - All setuid root programs should be in systems directories and should not be world readable-writable
 - /usr/bin/uucsend and /usr/lib/ex3.7preserve should not be setuid root in SunOS systems
 - All setuid to user programs should be known to user
 - setuid files generally require only execute access
- \$ chmod 4711 any_setuid_file

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Ownership

- **/etc should be owned by root, not bin**

`$ls -lFd /bin`

`drwxr-xr-x 4 bin system 3584 Jun 4 11:05 etc/` (this is bad!)

`$ chown root /etc` (now bin is owned by root)

- **/dev/mem, /dev/kmem and /dev/drum**
 - Should be owned by root and group kmem
 - Mode 640 recommended

`$ls -lFd /dev/mem`

`drwxr-xr-x 4 root kmem 4096 Aug 8 13:54 dev/mem` (this is good)

- **All devices (except terminals*) should be owned by root**
 - * - Should be owned by user until used logs out—then should be owned by root again

1-43

sendmail

- **alias, alias.dir and alias.pag in sendmail**
 - Should also be owned by root
 - Should not be world writable
- **Remove decode alias from /etc/aliases or /usr/lib/aliases**

1-44

System integrity

- **Inspect* system programs, network daemons, and access control programs for trojan horse programs**

- telnet
- /bin/login
- tftp
- su
- cron**
- at**

\$ sum /bin/login (compare to previous checksum)

OR run integrity checking tool such as COPS

* - Use checksum program kept offline

** - Any file referenced by cron and/or at should not be world-writable, either

1-45

Trusted hosts files

- **Ensure integrity of trusted hosts files (i.e., hosts.equiv, hosts.lpd and .rhosts files)**
 - **Inspect names of systems (e.g., unauthorized or not in your domain)**
 - **+ In these files allows universal access**
 - **Files should not be world-writable**

1-46

tftp

- **Secure tftp (trivial file transfer protocol)**
 - **Disable tftp unless it is necessary (e.g., for diskless servers)**
 - \$ get /etc/motd (If you get a response, /etc/passwd is vulnerable)**
 - **To disable tftp: delete or comment out tftp entry in /etc/inetd.conf)**
 - **If you run tftp, run the most recent version (Berkeley version 5.60) and run it "secure" (-s option in inetd.conf in SunOS)**

1-47

anonymous ftp

- **Secure anonymous ftp (file transfer protocol)**
 - **(If possible) - have dedicated anonymous ftp server**
 - **Asterisk out password fields in ~ftp/etc/passwd**
 - **Allow only group access in ~ftp/etc/group**
 - **Directory protections: 755 (generally)**
 - **netrc (contains login and initialization information for use by ftp's auto-login process) - should be readable only by owner**

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Account management

- Disable* unnecessary default accounts (e.g., sync)
- For disabled accounts, change login shell from /bin/sh to /bin/false

sys:*:2,2:::/bin/false

- Ensure that password file does not contain entries such as ::0:0::
- Recommendation—avoid:
 - Guest accounts**
 - Group accounts***

* - Replace the password with an asterisk

** - If guest accounts must be used, assign a non-trivial password, and disable account immediately after guest user leaves

*** - If multiple users are to have root privileges, assign multiple accounts with UID=0

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Other recommendations for system configuration

- /etc/exports
 - Should specify only hostnames or netgroups allowed to mount partitions
 - access= must not be empty, or any host may mount file system
 - After editing, enter

```
# exportfs -a
```

(to ensure that changes are put into effect)
- /etc/netgroup
 - Should specify only hostnames or netgroups allowed to mount partitions
 - Host and user fields must not be empty

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About UNIX vulnerabilities

- **Older versions of UNIX generally contain more vulnerabilities**
- **Your vendor can help you learn which specific vulnerabilities apply to the particular flavor and version of UNIX that you run**
- **Patches may have undesirable side effects, depending on configuration**

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UNIX vulnerabilities can be exploited several basic ways

- **Authentication bypass or back doors**
- **Compromise of passwords**
- **Unauthorized use of functions/privileges**
- **Disabling of protections**

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sendmail vulnerabilities

- **Hole 1 – an attacker can gain root privileges and execute commands on a remote system**
 - **Exploited by Morris Worm**
 - **Fixed in recent versions of major UNIX operating systems (e.g., BSD, SunOS, ULTRIX, etc.)**
- **Hole 2 – when used with .rhosts can allow attacker to gain access to a system without password**
 - **Present in SunOS 4.0.3, but fixed in version 4.1 (BugID 1028173)**
 - **Fixed in recent BSD sendmail releases (5.61 - 5.65)**
 - **Allows serious damage to be done to systems, especially if used in connection with .rhosts files**

1- 54

sendmail vulnerabilities (continued)

- **Hole 3 – an attacker can use this hole to overwrite critical system files (i.e., /etc/passwd, crontab)**
- **Other holes in older versions of UNIX, including decode, which allows users to create any file to which daemon has access**

1- 55

finger vulnerabilities

- **Hole 1 – allows a symbolic link to privileged files when finger is run setuid to root**
 - **Fixed in SunOS 4.0.3 (BugID 1015128) and BSD 4.3 Tahoe**
 - **Exploited by Morris Worm**
- **Hole 2 – allows an attacker to flood the input buffer with finger requests and subsequently gain unauthorized root privileges**
 - **Workaround – remove setuid from finger**
 - **Patch available from most vendors**

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finger vulnerabilities (continued)

- **finger is often used by an attacker to find other account names and home directories – can be used in connection with other vulnerabilities**

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ftp vulnerabilities

- **Hole 1 – allows unauthorized root access when anonymous ftp is enabled on older UNIX systems**
 - **Patch available**
 - **Allows user to modify any file in system (including /etc/passwd)**
- **Hole 2 – allows unauthorized file access (e.g., /etc/passwd)**
 - **Patch available**

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Other frequently exploited UNIX vulnerabilities

- **tftp** – permits an attacker to remotely read any world readable file (including password file)
 - Patch available (tftp -d to specify a directory to chroot into)
 - Workaround: disable function or replace with tftpbootd
- **/bin/mail** – on ULTRIX systems, makes it possible for an attacker to create a shell with EUID=0 (root)
- On Sun systems, **FSIRAND** function is predictable, allowing an unauthorized user to mount file systems remotely

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Other frequently exploited UNIX vulnerabilities (continued)

- **rcp (remote copy)** – allows remote copying of user readable files.
 - Workaround available
 - Patch available
- **nis (network information service)** and **nfs (network file system)** – many vulnerabilities
- **dump/restore** – runs as root and can allow unauthorized user to overwrite system files

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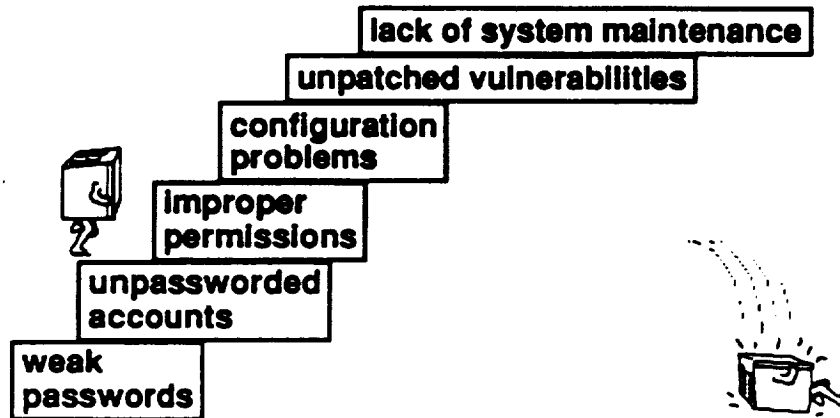
1-61

Other recommended strategies

- **Make backups—minimum of once every month**
- **Read system logs daily, checking especially for**
 - **Unsuccessful login attempts**
 - **su's to other accounts (especially root)**
 - **Unusual messages from daemons that log to the syslog file**
- **Be on the alert for unexplained changes in file sizes/dates, number of links to files, unsuccessful login attempts, etc.**
- **Encrypt sensitive files (but don't use Crypt!)**

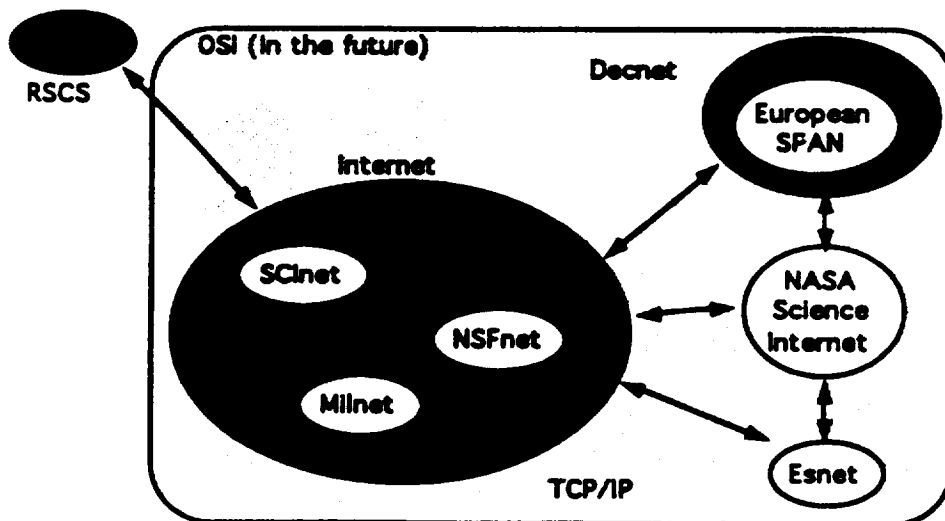
1-62

Scenario for the "big fall"



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The Internet



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HOW DO I SEND EMAIL TO *Whatshisname*?

(Actually, how to find someones E-mail address)

OR

How I spend too much of my time

By David M. Stern

Presentation to NASA Science Internet User Working Group

Spring 1992

Users often have difficulty in finding a proper Email address they can use to communicate with a colleague. This talk looks at tricks and techniques in discovering a users account and hostname in the DECnet, BITnet, X.29 and TCP/IP world with heavy emphasis on TCP/IP. Various Internet-wide resources and commonly available utilities (both VMS and UNIX) will be discussed.

There are basically three techniques one can use to determine a users email address:

- * Poor Mans Networking (phone him and ask)**
- * Search commonly available databases**
- * Use Network utilities**

Many sites have locally available online flat-files that users may perusing.

eg The Space Data Computing Division Cluster has the Goddard phonebook online at

SDCDCL::PUB_PROD:[PHONEBOOK]PHONEBOOK.DAT

EXAMPLE:

```
e search sdccl::pub_prod:[phonebook]phonebook.dat stern
66079 STERN DAVID M HSTX 930.4 28 W205J
68292 STERN DAVID P DR. 695.0 2 143
71736 STERN RICHARD ARICH CSC 832. 2N161 119
```

But these online files often don't contain email addresses. More importantly most remote users wouldn't know about such local services.

searching commonly available databases or flatfiles

To find a BITnet machine:

Search the host table that is periodically distributed to BITnet sites.

On a VMS machine running Joiner software, it is located in JAN_ROOT:[SYS]JANROUTES.JCP and is world-readable. In fact, you need not be a BITnet site to search this file. You can peruse it remotely. Thus if a hostname is 6 or fewer alphanumeric characters, it may be a BITnet node

EXAMPLE:

```
e search dftncl::jan_root:[sys]janroutes.jcp slac
DEFINE SLACESA /ROUTE-SCFMVS !BITNET US
DEFINE SLACPCR /ROUTE-SCFMVS !BITNET US
DEFINE SLACPHYS /ROUTE-SCFMVS !BITNET US
DEFINE SLACSCS /ROUTE-SCFMVS !BITNET US
DEFINE SLACSLC /ROUTE-SCFMVS !BITNET US
DEFINE SLACSLD /ROUTE-SCFMVS !BITNET US
DEFINE SLACSRV2 /ROUTE-SCFMVS !BITNET US
DEFINE SLACTBF /ROUTE-SCFMVS !BITNET US
DEFINE SLACTPC /ROUTE-SCFMVS !BITNET US
DEFINE SLACTWGM /ROUTE-SCFMVS !BITNET US
DEFINE SLACVM /ROUTE-SCFMVS !BITNET US
DEFINE SLACVX /ROUTE-SCFMVS !BITNET US
```

But how do you find out if someone is running Joiner software?
You can remotely translate a logical using the following technique:

\$MAIL NL: DFTNIC::JAN_ROOT

This forces VMS on the remote machine to internally interpret the logical jan_root and parrot back to you its equivalence in the error message.

This same technique can be used to see if a machine is running multinet, PMDF, DEC-PSI etc

EXAMPLE:

```

c mail nl: dftnic::jan_root
%MAIL-E-USERSPEC, invalid user specification '[SYS3.JANDFTNIC.]'
```

Compare this to the attempted translation of a logical that does NOT exist on the remote machine DFTNIC. Note the error message regurgitates the logical EXACTLY as you entered it.

```

c mail nl: dftnic::gobblede_guk
%MAIL-E-NOSUCHUSR, no such user GOBBLEDE_GUK at node DFTNIC
```

To find a VMS X.25 machine:

If you are trying to reach an X.25 site, you have DEC's PSI software and your systems manager has been kind enough to define logicals to equate easily remembered names with machine DTE numbers, the PSI table will list at least those DTE's that HAVE been defined.

This will only work locally. You can NOT remotely translate a PSI logical. Likewise you can't randomly browse another machines psi\$dte_table. So if you're not a PSI site, you're SOL.

NB. Because of security considerations, Sprintnet won't translate a number for you)

EXAMPLE:

```

c show log/table=psi$dte_table ssl "SSL" = "311032100160"
(PSIDTE_TABLE)
```

You don't need to give it a full name; wildcards are allowed. Further, you don't need to remember that ridiculous logical table name:

```

c show log/table='psi' 'venus'
(PSIDTE_TABLE)
"KDDVENUS" = "440881786124"
```

To find a DECnet machine:

First, let's assume it's in the NSI address space. If your local NCP database is up to date, try searching it (\$MCR NCP SH NODE string) Otherwise: \$SEARCH NSINIC::NSI_DECNET.COM string

This file lists all registered NSI-DECnet nodes. Again, if the nodename is 6 or fewer alphanumeric characters, it may be an NSI-DECnet node.

EXAMPLE:

```
e sea nsinic::nsi_decnet.com zar
DEFINE NODE 5.864 NAME MIZAR
DEFINE NODE 5.900 NAME ZARDOZ
DEFINE NODE 33.38 NAME MIZAR2
```

UNIX users can grab this file from the EAST gateway.

```
ftp nsinic.gsfc.nasa.gov.
cd [.nsinic.general_info]
get using_east_gateway.dat
```

PERHAPS ITS A HEPNET, EUROPEAN-SPAN, EUROPEAN-HEPNET, CANADIAN-SPAN, CANADIAN-HEPNET OR THENET NODE

The above nets share the same address space. A name may be multiply defined in two or more networks. Some areas are not defined in all of the above nets.

The same previously mentioned technique can still be used. You just need to know where to look. NSI_DECNET.COM has the following "gateways" defined

FNAL	(Fermi Lab in HEPnet)	42.1
ECD1	(European SPAN)	28.1
CANOTT	(Canadian SPAN)	18.100
THENIC	(Texas Higher Education Network)	25.213

The following machines are undefined in NSI_DECNET.COM

HEPCAN	(Canadian HEPnet)	18.1001
VXCERN	(European HEPnet)	22.190

So all you need to do is query one (or all) of the above regarding a nodename.

Note that you need to know (or guess) the full machine name. You cannot search on a partial string. Still, if you're only trying to identify on which network a known host resides, this method will suffice.

Once you decide on what net the machine resides, you can poor-mans-route email thru the appropriate gateway

EXAMPLE

```
$mail data.txt fnal::marie::smith
```

Bear in mind that nodenames are NOT necessarily unique to any of the previously mentioned DECnet networks.

You can also use X.500 White pages service:

EXAMPLE:

€ mc ncp tell fnal sh node marie

Node Volatile Summary as of 25-FEB-1992 13:53:01					Links
Node	State	Active	Delay	Circuit	
43.355 (MARIE)			BNA-0	42.33 (FNALRE)	

€ mc ncp sh node marie

Node Volatile Summary as of 25-FEB-1992 13:53:10					Links
Node	State	Active	Delay	Circuit	
5.779 (MARIE)			SVA-0	15.1019 (WAN1)	

If the user is a member of any government agency, they have automatically been registered in X.500 white pages. Unfortunately it's not the most user-friendly device and can be painfully slow if you don't know the organization the user belongs to. Further, it uses fuzzy logic for the search (this can be both good and bad). Finally, it might not even list their e-mail address (if they don't have an X.500 address). Nevertheless, users need not update this information themselves. Supposedly this is done automatically.

wp - graphics for vt100 OR display back to an Xwindow
fred - a more user-friendly front end
sd - for experts only

EXAMPLE:

\$ telnet wp.gsfc.nasa.gov
Trying... Connected to LEGO.GSFC.NASA.GOV

SunOS UNIX (lego)

login: fred

Welcome to NASA Goddard Space Flight Center

If you have any problems, send mail to rdunbar@dftrv.gsfc.nasa.gov

Try "help" for a list of commands "whois" for information on how to find people "manual" for detailed documentation "report" to send a report to the white pages manager

To find out about participating organizations, try "whois -org "

To find the people with lastname of Dunbar in NASA, try "whois dunbar -org nasa"

accessing service, please wait...

fred> help

Operations:

alias dish help quit set whois
area edit manual report thisis version

fred> whois -org nasa stern

Trying @c-US@o-National Aeronautics and Space Administration ...
4 matches found.

2. David P. Stern +1 301-286-8292
3. David Stern +1 301-286-6079
4. Richard Stern +1 804-824-1610
5. Robert Stern

(Partial results only--not all DSAs could be reached)

fred> whois -org nasa stern -full
(...Some entries not displayed for brevity ..)
Trying @c-US@o-National Aeronautics and Space Administration ...
Robert Stern (5)

NASA Johnson Space Center
Houston, TX 77058

Mailbox information:

c-usa.admd=telemail,prmd=jsc,org=nasa,ou=life,gn=robert,sn=stern,i=m

Locality: Houston, Texas

Name: Robert Stern, Johnson Space Center, National Aeronautics and Space Administration, US (5)
Modified: Tue Sep 24 21:17:48 1991 by: Manager, National Aeronautics and Space Administration, US (7)
(Partial results only--not all DSAs could be reached)

Display

fred> whois 2

Richard Dunbar (2)

aka: Richard Alan Dunbar

aka: Richard A. Dunbar

aka: Rick Dunbar

Jack of all trades

Goddard Space Flight Center

Code 630.4

Greenbelt, MD 20771

Mailbox information:

internet: rdunbar@dftrv.gsfc.nasa.gov

uucp: bfd!rdunbar

c=usa,admd=telemail,prmd=gsfc,org=nasa,ou=STX/Code630.4,gn=richard,sn=dunbar ,

i=a

Locality: Greenbelt, Maryland

Drinks: Captain Morgan's and Coke

Handle: @c=US@o=National Aeronautics and Space Administration@ou=Goddard Space Flight Center@cn=Richard Dunbar (2)

Note

+1 301-286-9430

US

Manager

Advanced Decision Systems

Alfred University

Artificial Technology

Bell-Northern Research

City College of CUNY

Cleveland University

Columbia University

Corporation for National Research Initiative

Defense Communications Agency

Department of Energy

DOD

Eastman Kodak Co.

ETE Laboratories, Inc.

Harvard-Purdue

Intelligence Systems, Inc.

INTERACTIVE Systems

Learners Literature National Laboratory

National Aeronautics and Space Administration

Manager

Perimeter

Reese Research Center

Spaulding Research Facility

Steven Yoo

...

Goldard Institute for Space Studies

Goldard Space Flight Center

Hong Kong

Japan Aerospace

Richard Barber

Yoo Han Ho

...

Headquarters

Jet Propulsion Laboratory

Carly Yoo

Catherine Yoo

Ray Barber

Steven Yoo

Tsun-Yun Yoo

Yoo Lee

...

Johnson Space Center

Kennedy Space Center

Lampl Research Center

Levi's Research Center

Marshall Space Flight Center

Michael Assembly Facility

Stennis Space Center

William Flight Facility



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Business Information:
Internet: mr@pfi.com
Internet: www.pfi.com

Biomedical Manager of the BPS/BIOM/PSI White Paper Pilot Project

Principal Implementer of the ISO Development Environment

A consultant according to release

Location: Mountain View, California

Home Phone: +1 415-288-4703

Drinks: food (and lots of it...)

Handle: BPS/BIOM/Performance Systems International/Biomedical Research and Development/Biomedical Research/Marshall Rose

Profiled: Jan 21 11:22:28 1990

Hmmm.... Got anything better?

YES

NETWORK UTILITIES

BITNET

If you are on a BITnet machine, you can send a test message/command to the user you intend to email to. Likewise, you can use the finger utility to verify that a machine name is legitimate and even get a listing of user currently logged on.

```
e send @jhuvms finger
(JHUVMS) - Username Program Login CPU Time TTY
(JHUVMS) - GGA 08:54 37.5 LTA702
(JHUVMS) - EBOLTZ TELNET 14:26 2.6 RTA3
(JHUVMS) - DOR_B014 EDT 13:13 17.1 NTY4
(JHUVMS) - JOHNHARR 14:01 8.0 TZA6672
(JHUVMS) - CAE_005 14:27 1.4 TZA6731
(JHUVMS) - ADM_ACWS DTR32 13:35 214.6 TZA6613
(JHUVMS) - EVH5150 13:14 133.4 TZA6547
(JHUVMS) - JU1972 14:28 4.1 TZA6732
```

... (output deleted for brevity)

But not all BITnet machines enable the finger utility. The following machine is an IBM. It is a valid BITnet host, just doesn't run finger.

```
e send @jhuvms finger
(JHUVMS) - INVALID COMMAND FINGER
e sea jan_root:[sys]janroutes.jcp jhuvms
DEFINE JHUVMS /ROUTE-SCFMVS !BITNET US
DEFINE JHUVMS /ROUTE-SCFMVS !BITNET US
```

Limitations:

You must be a bitnet site. Furthermore, using finger to identify a username on a valid BITnet host will only work if that user is currently logged on. Finally, illegal names aren't actually identified as such.

EXAMPLE:

```
e send gobblede@jhuvvm "test"
(JHUVM) - GOBBLEDE NOT LOGGED ON
```

DECNET

Although most people wouldn't think of VMSMAIL as a network utility for verifying an e-mail address, it can be used as just that. Because DECnet is a connection-oriented protocol, you can test an email address at the VMS MAIL "To:" prompt. You need not send a test message. This guarantees that you have found a legitimate email address. This same technique can be used to validate an X.25 mail address

EXAMPLE:

```
e mail
MAIL> s
To: ssl::system
CC: ^Z
Exit
MAIL> s
To: PSI%31103210703598::GREEN
CC: ^Z
Exit
MAIL>
```

Limitations:

Just because an email address is valid, it isn't necessarily the address you want. eg Is Pat Gary DFTNIC::GARY or DFTNIC::PGARY? Both are valid. (Of course, this is always true. Just something to keep in mind)

Sometimes a machine is down. To get around this, you can use a feature of multinet to queue it up.

EXAMPLE:

```
e mail
MAIL> s
To: ssp1::system
%MAIL-E-LOGLINK, error creating network link to node SSP1
-SYSTEM-F-NOSUCHNODE, remote node not currently reachable

MAIL> s
To: smtp%"ssp1::system"
CC:
Subj: Sample of queueing up DECnet mail for later delivery
```

FINGER

The same technique use to discover a legitimate username on a particular BITnet machine may also be used in the IP world.

EXAMPLE:

```
e finger @nsipo.nasa.gov
```

User	Real Name	What	Idle	TTY	Host	Console	Location
aschen	Anne Chen		0:02		*p7 nsipo.ar		(cumulus.arc.nas
bosco	Kathy J. Bosovich		0:30		*co zeus.arc		unknown
chen	Anni Chen		0:18		*co jadee.ar		unknown
defrenza	Michael DeFrenza		0:14		*p7 dscs.arc	(xexo:0.2)	
feinler	Jake Feinler				*co wonderla		unknown
hallie	Hallie Carlson				*pa nsipo.ar	(sophie.arc.nasa	
howe	Greg Howe		0:02		*co spot.arc		unknown
joanie	Joan C. Thompson		15:59		*p1 eudoxa.a	(:0.0)	
jones	Wm Prichard Jones		22:15		*p2 jehovah.	(:0.0)	
kamerdze	Jeanine Kamerdze		23:49		*pb noc.arc.	(:0.0)	
leon	Mark Leon		0:24		*pd nsipo.ar	(warford.arc.nas	
maria	Maria L. Gallagher		0:50		*co volcano.		unknown
mckernan	Daniel S. McKernan		2:20		*p9 dscs.arc	(fitsatcom.arc.n	
wade	A. Lee Wade		0:03		*co discover		unknown
wiersma	Al Wiersma				p1 noc.arc.	(noc.arc.nasa.go	

PING

Like the previously mentioned VMSMAIL verification technique, PING can be used to verify a hostname and insure that the machine is currently available.

EXAMPLE:

```
$ mu ping nsipo.nasa.gov
PING NSIPO.NASA.GOV (128.102.18.20): 56 data bytes
64 bytes from 128.102.18.20: icmp_seq=0 time=360 ms
64 bytes from 128.102.18.20: icmp_seq=2 time=290 ms
```

TRACEROUTE

Occasionally, you may come across a domain name that you don't recognize. Using TRACEROUTE and a little geography, one can often figure out physically where (at what local site) a machine resides

EXAMPLE:

```
$mu trace gdsnet.grumman.com
traceroute to GDSNET.GRUMMAN.COM (134.223.87.7), 30 hops max, 38
byte packets
 1 nsi-gw1 (128.183.10.40) 20 ms 10 ms 10 ms
 2 SURA.NSN.NASA.GOV (128.161.40.38) 30 ms 10 ms 10 ms
 3 nss-fix.sura.net (192.80.214.254) 40 ms 20 ms 30 ms
 4 Ithaca.NY.NSS.NSF.NET (129.140.74.9) 60 ms 60 ms 60 ms
 5 Ithaca.NY.NSS.NSF.NET (129.140.10.16) 60 ms 60 ms 60 ms
 6 cornell.syr.pop.psi.net (38.145.10.1) 60 ms 90 ms 70 ms
 7 syropop.albany.pop.psi.net (38.145.20.2) 120 ms 90 ms 70 ms
 8 albpop.nyc2.pop.psi.net (38.145.80.1) 80 ms 80 ms 70 ms
 9 nyc_C2.lan.nyc2.pop.psi.net (38.145.218.3) 130 ms 80 ms 80 ms
10 nyc1.grumman.psi.net (38.145.18.2) 100 ms 160 ms 100 ms
11 . . .
12 . . .
13 . . .
14 . . .
15 . . .
16 . . .
17 . . .
18 . . .
19 . . .
20 . . .
21 gdsnet.grumman.com (134.223.87.7) 110 ms ! 100 ms ! 110 ms
```

Limitation: On VMS machines running multinet, this is a privileged command. (Your systems manager may opt to install the command with privs...)

WHOIS

WHOIS is probably the single-most valuable utility for looking up email addresses. (After all, its sole purpose is to return a legitimate email address). This utility comes packaged with most TCP/IP products. It is based on the WHOIS lookup capability at the NIC.DDN.MIL

EXAMPLES:

```

€ whois stern
STERN, RICHARD
Stern, Alan (AS2235)
Stern, Alan (AS2236)
Stern, Allen M. (AMS49) STERNA@RUCKER-SAFETY.ARMY.MIL (DSN) 856-2826
Stern, Andre (AS127) stern@PRG.OXFORD.AC.UK
Stern, Catherine (CS231) cstern@APG-EMH5.APG.ARMY.MIL
Stern, Damon E. (DES83) dstern@ODS-HOST1.ARMY.MIL (DSN) 584-2208
Stern, David M. (DMS75) STERN@DFTNIC.GSFC.NASA.GOV (301) 286-6079
Stern, Eric S. (ES221) SFAE-CM-PM@MONMOUTH-EMH3.ARMY.MIL
Stern, Fred (FS67) STERN1@CCF.NRL.NAVY.MIL (908) 532-0263
Stern, Fredrick M. (FMS8) (319) 353-4692
Stern, Hal (HS71) (DSN) 675-2393 605-385-2393
Stern, Jack (JS855) EAID-IB-EE@CASEY-EMH1.ARMY.MIL (DSN) 730-5238
Stern, Les (LS233) TAMMC200@OBL-LINK.EUCOM.MIL
Stern, Neil H. (NHS2) 06332-86-6538 (DSN) 494-6538
nstern@PICA.ARMY.MIL (201) 724-6363
Stern, Richard
Stern, Robert (RS713) fastkorea@BELVOIR-EMH9.ARMY.MIL (703) 664-5482
(RS144) nsaparip@NOSC.MIL (DSN) 880-6363

```

To single out one record, look it up with "ixxx", where xxx is the handle, shown in parenthesis following the name, which comes first.

You can use WHOIS to find all users registered on a particular node

EXAMPLE:

```

$whois @dftnic
Bennett, Jerome (JB113) bennett@dftnic.gsfc.nasa.gov (301) 286
Broder, Sol (SB125) broder@dftnic.gsfc.nasa.gov (301) 286-
Cheek, Jack (JC331) CHEEKS@dftnic.gsfc.nasa.gov (301) 286-
Cosner, Charles (CC115) cosner@dftnic.gsfc.nasa.gov (301) 286-
Gary, James P. (JPG18) pgary@dftnic.gsfc.nasa.gov (301) 286-
Jha, Ashok (AJ29) jha@dftnic.gsfc.nasa.gov (301) 286-
Lang, Paul A. (PAL10) lang@dftnic.gsfc.nasa.gov (301) 286-
Lev, Brian (BL41) lev@dftnic.gsfc.nasa.gov (301) 286-
Stern, David M. (DMS75) STERN@dftnic.gsfc.nasa.gov (301) 286-
Yurcik, William J. (WY4) yurcik@dftnic.gsfc.nasa.gov (301) 286-

```

To single out one record, look it up with "ixxx", where xxx is the handle, shown in parenthesis following the name, which comes first.

You can also find out whois is responsible for a particular network using either the Class B address mask or the network name

EXAMPLE:

e whois 128.161.0.0
NASA Ames Research Center (NET-NSN-NET) Moffett Field, CA 94035

Netname: NSN-NET Netnumber: 128.161.0.0
Coordinator: Medin, Milo (MSM1)
MEDIN@NSIPO.NASA.GOV
(415) 604-6440 (FTS) 464-6440

Domain System inverse mapping provided by:
NSIPO.ARC.NASA.GOV 128.102.18.20
ORION.ARC.NASA.GOV 128.102.18.10

Record last updated on 03-Jan-91.

To see this host record with registered users, repeat the command with a star (*) before the name; or, use '%' to show JUST the registered users.

EXAMPLE:

e whois nih.gov

National Institutes of Health (NIH-DOM)
National Library of Medicine
8600 Rockville Pike
Bethesda, MD 20894

Domain Name: NIH.GOV
Administrative Contact, Technical Contact, Zone
Contact: Aronson, Jules P. (JA1)
ARONSON@MCS.NLM.NIH.GOV
(301) 496-9300 (FTS) 496-9300

Record last updated on 02-Aug-91.

Domain servers in listed order:
LHC.NLM.NIH.GOV 130.14.1.128 UUCP-GW-1.PA.DEC.COM
161.0.18 RAY.NLM.NIH.GOV 130.14.20.2 SUN1.NLM.NIH.GOV
130.14.20.30 NS.NIH.GOV 128.231.128.251 DXI.NIH.GOV
128.231.64.1

To see this host record with registered users, repeat the command with a star (*) before the name; or, use '%' to show JUST the registered users.

Further capabilities are allowed if you telnet nic.ddn.mil

Limitations: A user needs to register at the NIC in the first place. He/she is also responsible for keeping the information current. To register,
ftp nic.ddn.mil
get /netinfo/user-template.txt

NSLOOKUP

NSLOOKUP allows you to convert IP numbers to names, convert mx records, dump all nodes a nameserver knows about and more.

If you know a partial host name or know their domain and think you'd recognize the hostname if you saw it, find a nameserver in that domain and dump all nodes.

But first, it may be useful to have a list of all domain names.

Ftp to NSINIC, drop down to [.nsinic.tcp-ip.docs] and grab DOMAIN-INFO.TXT (or get it from NIC.DDN.MIL, or DECnet copy it from:

NSINIC::DISK\$NSINIC:[ANONYMOUS.FILES.NSINIC.TCP-IP.DOCS]DOMAIN.-INFO.TXT

You may also find the companion document, US-DOMAIN.TXT, (in the same directory) useful.

[NETINFO:DOMAIN-INFO.TXT]

DDN NIC DOMAIN SUMMARY 11-Dec-89

[NSI NIC note: Each of the "domains" referred to in the following list is the last part of a full name Internet address; for example, GOV is the domain for the address "nsinic.gsfc.nasa.gov" and COM is the domain for "stx.com".]

AT

No known domains under this top level domain. (AUSTRIA)

..... (parts of this document removed for brevity)

CA

No known domains under this top level domain. (CANADA)

COM	3M.COM	A-T.COM	AATI.COM	AB.COM
ABBOTT.COM	ABLE.COM	ACADCH.COM	ACC.COM	ACCI.COM
ACS.COM	ACH.COM	ADAMAX.COM	ADDELIE.COM	ADOBE.COM
ADS.COM	ADVSCI.COM	AGFA.COM	AGS.COM	AHA.COM
AIC.COM	AII.COM	ALADDIN.COM	ALCOA.COM	ALGORISTS.COM
ALLIANT.COM	ALLIED.COM	ALPHACDC.COM	ALPHA.COM	ALPHALPHA.COM
AMC.COM	AMCC.COM	AND.COM	AMDAHL.COM	ALLOS.COM
AMI.COM	AMIX.COM	AMOCO.COM	AMP.COM	AMERITECH.COM
AMA.COM	ANALYTICS.COM	ANDERSEN.COM	AOCGL.COM	AMS.COM
APOLLO.COM	APPLE.COM	APPLICOM.COM	APPLIX.COM	APLDBIO.COM
ARBORTEXT.COM	ARDENT.COM	ARIEL.COM	ARRIS.COM	APS.COM
ASI.COM	ASTROSOFT.COM	ATENG.COM	ATHENANET.COM	ASA.COM
ATHSYS.COM	ATI.COM	ATFAL.COM	ATT.COM	ATHERTON.COM
AURORA.COM	AUSPEX.COM	AUTO-TROL.COM	AUTODESK.COM	AURATEK.COM
BALLY.COM	BANG.COM	BANYAN.COM	BARN.COM	AUTOSYS.COM
BASIS.COM	BBC.COM	BBM.COM	BDM.COM	BARTON.COM
BEARTRACK.COM	BEDROCK.COM	BELL-ATL.COM	BELLCORE.COM	BDT.COM
BILW.COM	BITBLOCKS.COM	BITSTREAM.COM	BLLI.COM	BENDIX.COM
BOEING.COM	BOHICA.COM	BOSTECH.COM	BP.COM	BMA.COM
				BRS.COM

..... (parts of this document removed for brevity)

EXAMPLE

Finding a Grumman node called GDSsomething

```
$MU NSLOOKUP
Default Server: dftsrv.gsfc.nasa.gov
Address:
128.183.10.134
```

```
> SET QUERY/TY=NS
> GRUMMAN.COM
Server: dftsrv.gsfc.nasa.gov
Address: 128.183.10.134
```

```
Non-authoritative answer:
grumman.com nameserver = NS.PSI.NET
grumman.com nameserver = NS2.PSI.NET
```

```
Authoritative answers can be found from:
grumman.com nameserver = NS.PSI.NET
grumman.com nameserver = NS2.PSI.NET
NS.PSI.NET internet address = 192.33.4.10
NS2.PSI.NET internet address = 192.35.82.2
```

```
> SERVER NS.PSI.NET
Default Server: ns.psi.net
Address: 192.33.4.10
```

```
> LS GRUMMAN.COM
[ns.psi.net]
grumman.com.
ns.psi.net.
grumman.com.
n2ngw.nyser.net.
gdsnet
gdstech
gdsdec
> EXIT
```

```
server = ns.psi.net
192.33.4.10
server = n2ngw.nyser.net
192.35.82.2
134.223.87.7
134.223.87.8
134.223.87.8
```

Often the above listing is quite large.
You can therefore pre-sort it.

EXAMPLE:

Searching for host that sounds something like EAST in domain BELWUE in Germany

```
$ mu nslookup
Default Server: nsisrv.gsfc.nasa.gov
Address: 128.183.10.134
```

```
> set query/ty=ns
> belwue.de
```

```
Address: 128.183.10.134
Non-authoritative answer:
belwue.de nameserver = noc.BelWue.DE
belwue.de nameserver = deins.Informatik.Uni-Dortmund.DE
belwue.de nameserver = rusmv8.RUS.Uni-Stuttgart.DE
belwue.de nameserver = ns.Germany.EU.net
```

```
Authoritative answers can be found from:
BelWue.de nameserver = noc.BelWue.DE
BelWue.de nameserver = deins.Informatik.Uni-Dortmund.DE
BelWue.de nameserver = rusmv8.RUS.Uni-Stuttgart.DE
BelWue.de nameserver = ns.Germany.EU.net
noc.BelWue.DE internet address = 129.143.2.1
deins.Informatik.Uni-Dortmund.DE internet address = 192.35.64.34
rusmv8.RUS.Uni-Stuttgart.DE internet address = 129.69.1.9
ns.Germany.EU.net internet address = 192.76.144.66
> server noc.belwue.de
Default Server: noc.belwue.de
Address: 129.143.2.1
```

```
> ls belwue.de > temp.txt
[noc.belwue.de]
#####
Received 465 records.
```

```
> view temp.txt
AWI-Bremerhaven
AWI-Bremerhaven
BA-Mosbach
BA-Mosbach
BA-Stuttgart
BA-Stuttgart
BeiWue.DE.
BeiWue.DE.
BeiWue.DE.
BeiWue.DE.
BeiWue.DE.
BeiWue.DE.
DKFZ-Heidelberg
DKFZ-Heidelberg
DKFZ-Heidelberg
FH-Aalen
FH-Aalen
.... (printout goes on, and on...)
```

```
129.143.249.2
134.1.1.254
188.1.132.131
192.124.236.254
129.143.227.2
141.108.1.254
server = deins.Informatik.Uni-Dortmund.DE
server = noc.BeiWue.DE
server = ns.Germany.EU.net
server = rusmv5.RUS.Uni-Stuttgart.DE
server = rusmv8.RUS.Uni-Stuttgart.DE
129.143.229.2
188.1.132.34
192.55.188.24
141.18.1.254
188.1.132.51
```

```
> exit
$ search temp.txt bast
bastm-rz-gw 141.108.1.254
bast-st2-gw 129.143.227.2
st2-bast-gw 129.143.227.1
```

BUT WHAT IF THE DOMAIN IS TOO NEW TO BE IN THIS LISTING?

```
$mu nslookup/typ=soa wisc.edu
Default Server: dfisrv.gsfc.nasa.gov
Address: 128.183.10.134

WISC.EDU
origin = cs.wisc.edu
mail addr = hostmaster.cs.wisc.edu
serial = 920304
refresh = 28800 (8 hours)
retry = 14400 (4 hours)
expire = 3600000 (41 days 16 hours)
minimum ttl = 86400 (1 day)
```

Other neat things you can do with NSLOOKUP

```

NSLOOKUP / TYPE = A      address (default)
                          any and all info
                          ANY
                          CNAME Canonical name (alias)
                          HINFO Host information eg machine type
                          MX Mail exchange record
                          NS Name server
                          PTR back-translate number to name
                          SOA Start of authority
                          WKS Well known services
  
```

If you can't translate a hostname, you might want to query one of the seven Internet ROOT SERVERS

```

NS.NIC.DDN.MIL
KAVA.NISC.SRI.COM
AOS.BRL.MIL
C.NYSER.NET
TERP.UMD.EDU
NS.NASA.GOV
NIC.NORDU.NET
  
```

EXAMPLE

```
$ mu nslookup
Default Server: dftrsv.gsfc.nasa.gov
Address: 128.183.10.134
```

```
> server ns.nasa.gov
Default Server: ns.nasa.gov
Addresses: 128.102.16.10, 192.52.195.10
```

```
> ls ca.
[ns.nasa.gov]
CA.
RELAY.CDDNET
CA.
NNSC.NSF.NET
CA.
CLOUDSO.CRIM
CA.
UGW.UTCS.UTORONTO.CA
UGW.UTCS.UTORONTO.CA
GPU.UTCS.UTORONTO.CA
UGW.UTCS.UTORONTO.CA
UGW.UTCS.UTORONTO.CA
NEAT.CS.UTORONTO
VAN-BC.WIMSEY.BC
NS.LSUC.ON
GATEWAY.BNR
CLUOSO.CRIM
BLACKADDER.CIS.MCMASTER
BALDRIC.CIS.MCMASTER
RELAY.CDDNET
CLYDE.CONCORDIA

server = RELAY.CDDNET.CA
192.73.5.1
server = NNSC.NSF.NET
128.89.1.178
server = CLOUDSO.CRIM.CA
192.26.210.1
server = UGW.UTCS.UTORONTO.CA
128.100.102.3
128.100.100.3
128.100.100.1
128.100.102.3
128.100.100.3
128.100.1.65
192.48.234.1
142.57.1.1
192.58.194.71
192.26.210.1
130.113.0.62
130.113.0.63
192.73.5.1
132.205.1.1
```

But sometimes the address you're given doesn't seem like a legitimate hostname

Perhaps it's an MX record. That is, mail destined for that host is sent thru a "Mail exchanger" or gateway that forwards it appropriately.

EXAMPLE:

```
$ mu trace bypass.dnet.nasa.gov
r2vuva$dia2:[sys0.syscommon.][multinet]multinet_traceroute.exe.2:
unknown host BYPASS.DNET.NASA.GOV
```

```
$ mu nslookup/ty=mx bypass.dnet.nasa.gov
Server: dftrsv.gsfc.nasa.gov
Address: 128.183.10.134

Non-authoritative answer:
BYPASS.DNET.NASA.GOV preference = 0, mail exchanger =
east.gsfc.nasa.gov
east.gsfc.nasa.gov internet address = 128.183.104.4
```

EXAMPLE:

```
$ mu nslookup/ty=mx nasamail.nasa.gov
Server: dftrsv.gsfc.nasa.gov
Address: 128.183.10.134

NASAMAIL.NASA.GOV preference = 5, mail exchanger =
gemini.arc.nasa.gov
NASAMAIL.NASA.GOV preference = 10, mail exchanger =
homer.arc.nasa.gov
gemini.arc.nasa.gov internet address = 128.102.18.6
```

The safest way to use NSLOOKUP is probably with the /type=any qualifier

EXAMPLE:

```
$ mu nslookup/ty=any nasamail.nasa.gov
Server: dftsrv.gsfc.nasa.gov
Address: 128.183.10.134

Non-authoritative answer:
NASAMAIL.NASA.GOV preference = 5, mail exchanger =
geminini.arc.nasa.gov
NASAMAIL.NASA.GOV preference = 10, mail exchanger =
homer.arc.nasa.gov

Authoritative answers can be found from:
nasa.gov nameserver = NS.NASA.GOV
nasa.gov nameserver = CRAYON.NAS.NASA.GOV
nasa.gov nameserver = ORION.ARC.NASA.GOV
nasa.gov nameserver = JPL-MIL.JPL.NASA.GOV
geminini.arc.nasa.gov internet address = 128.102.18.6
homer.arc.nasa.gov internet address = 128.102.18.66
NS.NASA.GOV internet address = 128.102.16.10
NS.NASA.GOV internet address = 192.52.195.10
CRAYON.NAS.NASA.GOV internet address = 129.99.23.6
ORION.ARC.NASA.GOV internet address = 128.102.18.10
ORION.ARC.NASA.GOV internet address = 128.102.128.2
JPL-MIL.JPL.NASA.GOV internet address = 128.149.1.101
JPL-MIL.JPL.NASA.GOV internet address = 128.149.4.1
JPL-MIL.JPL.NASA.GOV internet address = 128.149.28.2
```

But unless you know how to read this, you may come down with a bad case of information overload.

Additionally, type=mx only interprets the address STYLE, not the hostname itself.

EXAMPLE:

```
$ mu nslookup/ty=mx mumble.dnet.nasa.gov
Server: dftsrv.gsfc.nasa.gov
Address: 128.183.10.134

Non-authoritative answer:
MUMBLE.DNET.NASA.GOV preference = 0, mail exchanger =
east.gsfc.nasa.gov
east.gsfc.nasa.gov internet address = 128.183.104.4
```

Note that nowhere in the above example does it mention that this is not a valid address. So type=mx needs to be used in conjunction with a straight nslookup or SMTP to determine the address.

NSLOOKUP can also be used to back-translate a number to a node

EXAMPLE:

\$ MU NSLOOKUP/TYPE=PTR 128.102.18.10

Server: dftsrv.gsfc.nasa.gov

Address: 128.183.10.134

10.18.102.128.in-addr.arpa name = orion.arc.nasa.gov

SMTP

We all take mail for granted. The front ends (mailers) we use often hide what happens on the lower levels. Using the lower levels of Simple Mail Transfer Protocol (SMTP), one can verify an address, expand a mail distribution list and more.

In the following example, the syntax used is for VMS machine running multinet. Other variations of TCP/IP require the syntax "TELNET host 25"

EXAMPLE:

```

$telnet/port=25  nslsrv
Trying... Connected to NSISRV.GSFC.NASA.GOV
EXPN ADFTO
220 nslsrv.gsfc.nasa.gov Sendmail 5.57/Ultrix3.0-C ready at Tue,
25 Feb 92 13:45:30 -0500
250-Javad Boroumand <javad>
250-Yonsook Enloe <yonsook>
250-<yurcik@dftnic.gsfc.nasa.gov>
250-<tencati@dftnic.gsfc.nasa.gov>
250-<stern@dftnic.gsfc.nasa.gov>
250-<sellers@amarna.gsfc.nasa.gov>
250-Scott W. Rogers <rogers>
250-<lev@dftnic.gsfc.nasa.gov>
250-<lang@dftnic.gsfc.nasa.gov>
250-<jamil@lego.gsfc.nasa.gov>
250-<jackson@dftnic.gsfc.nasa.gov>
250-<pgary@dftnic.gsfc.nasa.gov>
250-<rdunbar@lego.gsfc.nasa.gov>
250-Bill Fink <bill@wizard.gsfc.nasa.gov>
250 <bennett@dftnic.gsfc.nasa.gov>
250 <rdunbar@lego.gsfc.nasa.gov>
VRFY RICK
550 rick... User unknown: No such file or directory
VRFY RDUNBAR
250 Rick Dunbar <rdunbar@lego.gsfc.nasa.gov>
QUIT

```

Now let's put it all together. The following example verifies the address **molnar@telly.on.ca**

EXAMPLE:

e mu ping telly.on.ca
r2vuv\$dia2:[sys0.syscommon.][multinet]multinet_ping.exe:
unknown host TELLY.ON.CA

e mu nslookup/ty=mx telly.on.ca

Server: dfhsrv.gsfc.nasa.gov
Address: 128.183.10.134

TELLY.ON.CA preference = 10, mail exchanger =
gpu.utcs.utoronto.ca internet address = 128.100.100.1
gpu.utcs.utoronto.ca internet address = 128.100.102.1
NSINIC e mu nslookup/type=mx gpu.utcs.utoronto.ca
Server: dfhsrv.gsfc.nasa.gov
Address: 128.183.10.134

Non-authoritative answer:
GPU.UTCS.UTORONTO.CA
inet address = 128.100.100.1, protocol = tcp
smtp

NSINIC e flinger molnar@gpu.utcs.utoronto.ca
Login name: molnar In real life: Tom Molnar
Group: UTCS/Systems
Office: MP350, x-8853 Home phone: Send E-mail
CAN: 1992 PIN: 17958 TDD: uzf
Directory: /home/gpu/u1/molnar Shell: /bin/tcsh
New mail received Mon Mar 3 06:28:54 1992;
unread since Mon Mar 3 06:28:57 1992

Signature:
Tom Molnar
Unix Systems Group, University of Toronto Computing Services

Login name: qm In real life: Tom Molnar
CAN: 1992 PIN: 17958 TDD: uzf
Directory: /home/gpu/u1/molnar Shell: /bin/tcsh
New mail received Mon Mar 3 06:28:54 1992;
unread since Mon Mar 3 06:28:57 1992

NSINIC e telnet/port=25 gpu.utcs.utoronto.ca

Trying... Connected to GPU.UTCS.UTORONTO.CA, a SUN4/490 running
SUNOS4.1.1.

220 gpu.utcs.utoronto.ca Server SMTP ready at Wed, 26 Feb 1992
09:36:34 -0500
expn molnar
250-local delivery for Tom Molnar <molnar>
quit

TCP/IP Tutorial

**John McMahon
TGV, Inc.**

**Due to size and copyright considerations,
Mr. McMahon's tutorial materials will be
made available upon request to the NSI NIC.**

IV. Exhibit Summaries

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Third Annual NSIUWG Conference NSI Networking in the Nineties EXHIBITORS

(All exhibits are located in the Annapolis Room on the lobby level. Exhibitors will be available from 1:30 to 5:00 Tuesday through Thursday and 10:00 to noon on Friday.)

NASA Science Internet User Support Office

Members of the NSI User Support office will inform NSI users of the various services available to them as a result of being a member of the NSI user community.

NASA Science Internet Network Operations Center

Members of the NASA Science Internet Operations staff will demonstrate real time monitoring capabilities of the NSI/NOC located at the NASA Ames Research Center.

NASA Center for Computational Studies

The NCCS provides computational services and tools in a data rich environment to scientists supported by NASA's Office of Space Sciences and Applications. Programs include a computational physics group and a scientific visualization laboratory. Resources include: Cray Y-MP 8/464, Convex 220, MasPar MP-1, Ultra network, and associated mass data storage and delivery systems.

TAE Plus

TAE is a software development tool.

GDAAC

NCDS and PLDS The Earth Observing Systems Goddard Distributed Active Archive Center represents global change disciplines through its baseline systems: The NASA Climate Data System and Polar Land Data System. The Goddard DAAC is developing innovative data management systems to handle the tremendous volume of data expected in the EOS era.

EOSDIS IMS Version

The EOSDIS IMS Version 0 Inventory Interoperability Proof of Concept Demonstration is a cooperative effort between the IMS system level coordination/development team and the distributed DAAC software development teams. This software demonstrates the capability to access heterogeneous distributed inventories of scientific metadata.

MASTER DIRECTORY

The Master Directory is a free on-line data information service. It is a multidisciplinary and multi-agency information service.

NSIUWG: March/April, 1992

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13. ABSTRACT (Maximum 200 words) The NASA Science Internet (NSI) User Support Office (USO) sponsored the Third Annual NSI User Working Group (NSIUWG) Conference March 30 through April 3, 1992, in Greenbelt, MD. Approximately 130 NSI users attended to learn more about the NSI, hear from projects which use NSI, and receive updates about new networking technologies and services. This report contains material relevant to the conference; copies of the agenda, meeting summaries, presentations, and descriptions of exhibitors. Plenary sessions featured a variety of speakers, including NSI project management, scientists, and NSI user project managers whose projects and applications effectively use NSI, and notable citizens of the larger Internet community. The conference also included exhibits of advanced networking applications; tutorials on internetworking, computer security, and networking technologies; and user subgroup meetings on the future direction of the conference, networking, and user services and applications.				
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